DRAFT

Draft Scoring for Evaluation of Closure Options
Closure Options Evaluation Worksheet
Ash Basin Closure - Master Programmatic Document
Duke Energy

Site Name: Belews Creek Steam Station
Date: 3/6/2017

1	= Option-Specific User Input
1	= Calculated Value

Placeholder values have been entered in "User Input" cells to prevent division by zero error text in calculated score cells.

Threshold Criteria: All closure options must comply with the following threshold criteria based on Duke Energy Guiding Principals for Ash Basin Closure
1. Provide continued geotechnical stability meeting appropriate safety factors under applicable loading conditions
2. Provide flow capacity and erosion resistance during design storm and flooding conditions
3. Effectively mitigate groundwater impacts (in conjunction with GW remediation where present)
4. Comply with applicable state and federal regulations (e.g. North Carolina Coal Ash Management Act)

Option	Description
1	Option 1 - Closure in Place
2	Option 2 - Hybrid Closure Option (Removal for areas under water and Closure in Place for the ash delta): Reduced Closure Footprint Within the Ash Basin
3	Option 3 - Removal: Onsite Landfill Inside the Excavated Ash Basin
4	Option 4 - Removal: Onsite Landfill Outside the Ash Basin
5	Option 5 - Removal: Offsite Disposal
A	
B	

Note: Options that did not meet threshold criteria should be listed in the Options Summary table above for completeness

Environmental Protection and Impacts	Weight:	30%		User Input					Value that Scores 10	Value that Scores 0	Calculated or User Selected Score					Criterion	Contribution to
Criterion	Scoring System	Required Input	Units	Option 1	Option 2	Option 3	Option 4	Option 5			Option 1	Option 2	Option 3	Option 4	Option 5	Weight	Total Score
Modeled surface water impact	Refer to EM Sub-Scoring Sheet	This Area Not Used For Interpretation of Environmental Modeling Results									9	9	10	10	10	21%	6.3%
Modeled off-site impact	Refer to EM Sub-Scoring Sheet	This Area Not Used For Interpretation of Environmental Modeling Results									8	8	10	10	10	43%	12.9%
Groundwater impact beyond the waste boundary	Refer to EM Sub-Scoring Sheet	This Area Not Used For Interpretation of Environmental Modeling Results									2	2	4	4	4	21%	6.3%
Air emissions off-site (based on miles driven)	Interpolation. Min value scores 10. Max value scores 0.	Truck miles driven	Miles	0	0	0	0	100	0	100	10	10	10	10	0	5%	1.5%
Air emissions on-site (based on gallons of fuel consumed) from closure implementation	Interpolation. Min value scores 10. Max value scores 0.	Gallons of fuel consumed	Gallons	1239885	2255272	11925015	9669743	9669743	1239885	11925015	10	9	0	2	2	5%	1.5%
Avoidance of greenfield disturbance	Interpolation. Min value scores 10. Max value scores 0.	Disturbed acres of greenfield	Acres	50	30	40	130	130	30	130	8	10	9	0	0	5%	1.5%
Weighted Totals (Contribution to Total Score)											**2.1**	**2.2**	**2.5**	**2.4**	**2.2**		

Cost	Weight:	35%		User Input					Value that Scores 10	Value that Scores 0	Calculated or User Selected Score					Criterion	Contribution to
Criterion	Scoring System	Required Input	Units	Option 1	Option 2	Option 3	Option 4	Option 5			Option 1	Option 2	Option 3	Option 4	Option 5	Weight	Total Score
Closure Cost	Interpolation. Min value scores 10. Max value scores 0.	Closure Cost	USD	$58,000,000	$105,000,000	$286,000,000	$268,000,000	$929,000,000	$ 58,000,000.00	$ 929,000,000.00	10.0	9.5	7.4	7.6	0.0	80%	28.0%
Operation, Maintenance and Monitoring Cost		OM&M Cost	USD	$7,500,000	$7,500,000	$8,200,000	$8,200,000	$7,000,000	$ 7,000,000.00	$ 8,200,000.00	5.8	5.8	0.0	0.0	10.0	20%	7.0%
Weighted Totals (Contribution to Total Score)											**3.2**	**3.1**	**2.1**	**2.1**	**0.7**		

Schedule	Weight:	15%		User Input					Value that Scores 10	Value that Scores 0	Calculated or User Selected Score					Criterion	Contribution to
Criterion	Scoring System	Required Input	Units	Option 1	Option 2	Option 3	Option 4	Option 5			Option 1	Option 2	Option 3	Option 4	Option 5	Weight	Total Score
Initiation Time	Interpolation. Min value scores 10. Max value scores 0.	Time to move first ash	Months	30	36	54	54	36	30	54	10	8	0	0	8	30%	4.5%
Construction Duration		Estimated durations	Months	76	88	150	138	129	76	150	10	8	0	2	3	70%	10.5%
Weighted Totals (Contribution to Total Score)											**1.5**	**1.2**	**0.0**	**0.2**	**0.7**		

EXHIBIT DJW - 7.2.2
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Memorandum

Duke Energy, CCP Closure Engineering

Date:	November 03, 2016
To:	Mehdi Maibodi
From:	Charles Smith
Reviewed by:	Henry Taylor
Subject:	Closure Options Evaluation Buck Station Salisbury, Rowan County, North Carolina

Duke Energy Carolinas, (Duke Energy) has reviewed the draft *Potential Closure Options Evaluation* for the ash basin located at Duke Energy's Buck Station (facility or site), located at 1555 Dukeville Road, Salisbury, Rowan County, North Carolina, prepared by HDR Engineering, Inc. of the Carolinas (HDR) dated April 29, 2016. The draft *Potential Closure Options Evaluation* involved developing ash basin closure strategies and evaluating these options relative to one another. A conceptual-level design for each closure option was developed to provide required inputs to enable this comparison. The evaluation criteria and process defined in the April 29, 2016 draft *Evaluation* were used to rank the closure options and the selected option will be advanced to permit level design.

Since completion of the draft *Potential Closure Options Evaluation*, additional information has become available and changes have been made to the programmatic document, which provides guidance for performance of the Options Evaluation. In lieu of revising and finalizing the draft *Evaluation* in its entirety, Duke Energy has reviewed and revised the scoring matrix to provide consistency with the programmatic document to evaluate potential changes to the proposed closure program. This memorandum presents a summary of the draft *Evaluation* including an overview of the closure options evaluated, the revised Draft Scoring for Evaluation of Closure Options, a discussion of any significant changes in the draft Evaluation and Draft Scoring for Evaluation of Closure Options (included herein), and identifies the most favorable option based on the outcome of the review.

DRAFT

Draft Scoring for Evaluation of Closure Options
Closure Options Evaluation Worksheet
Ash Basin Closure - Master Programmatic Document
Duke Energy

Site Name: Buck
Date: 3/6/17

1	= Option-Specific User Input
1	= Calculated Value

Placeholder values have been entered in "User Input" cells to prevent division by zero error text in calculated score cells.

Threshold Criteria: All closure options must comply with the following threshold criteria based on Duke Energy Guiding Principals for Ash Basin Closure
1. Provide continued geotechnical stability meeting appropriate safety factors under applicable loading conditions
2. Provide flow capacity and erosion resistance during design storm and flooding conditions
3. Effectively mitigate groundwater impacts (in conjunction with GW remediation where present)
4. Comply with applicable state and federal regulations (e.g. North Carolina Coal Ash Management Act)

Option	Description
1	Hybrid - Consolidate CCR in Cell 1
1A	Hybrid - Consolidate CCR Away from Yadkin River
2	New On-Site Landfill
3	Close In Place
4	Off-Site Landfill

Note: Options that did not meet threshold criteria should be listed in the Options Summary table above for completeness

Environmental Protection and Impacts	Weight:	30%		User Input					Value that Scores 10	Value that Scores 0	Calculated or User Selected Score					Criterion	Contribution to
Criterion	Scoring System	Required Input	Units	Option 1	Option 2	Option 3	Option 4	Option 5			Option 1	Option 1A	Option 2	Option 3	Option 4	Weight	Total Score
Modeled surface water impact	Refer to EM Sub-Scoring Sheet	This Area Not Used For Interpretation of Environmental Modeling Results									6	6	8	6	8	21%	6.3%
Modeled off-site impact	Refer to EM Sub-Scoring Sheet	This Area Not Used For Interpretation of Environmental Modeling Results									10	10	10	10	10	43%	12.9%
Groundwater impact beyond the waste boundary	Refer to EM Sub-Scoring Sheet	This Area Not Used For Interpretation of Environmental Modeling Results									8	8	9	8	9	21%	6.3%
Air emissions off-site (based on miles driven)	Interpolation. Min value scores 10. Max value scores 0.	Truck miles driven	Miles	6.93	0	0	0	76	0	76	9	10	10	10	0	5%	1.5%
Air emissions on-site (based on gallons of fuel consumed) from closure implementation	Interpolation. Min value scores 10. Max value scores 0.	Gallons of fuel consumed	Gallons	2,640,000	1,558,000	6,568,000	850,000	6,068,000	850000	6568000	7	9	0	10	1	5%	1.5%
Avoidance of greenfield disturbance	Interpolation. Min value scores 10. Max value scores 0.	Disturbed acres of greenfield	Acres	0	3.4	0	25.8	43.9	0	43.9	10	9	10	4	0	5%	1.5%
Weighted Totals (Contribution to Total Score)											2.6	2.6	2.7	2.5	2.4		

Cost	Weight:	35%		User Input					Value that Scores 10	Value that Scores 0	Calculated or User Selected Score					Criterion	Contribution to
Criterion	Scoring System	Required Input	Units	Option 1	Option 2	Option 3	Option 4	Option 5			Option 1	Option 1A	Option 2	Option 3	Option 4	Weight	Total Score
Closure Cost	Interpolation. Min value scores 10. Max value scores 0.	Closure Cost	USD	$131,000,000	$71,000,000	$221,000,000	$57,000,000	$593,000,000	$ 57,000,000.00	$ 593,000,000.00	8.6	9.7	6.9	10.0	0.0	80%	28.0%
Operation, Maintenance and Monitoring Cost		OM&M Cost	USD	$15,000,000	$17,000,000	$20,000,000	$22,000,000	$9,000,000	$ 9,000,000.00	$ 22,000,000.00	5.4	3.8	1.5	0.0	10.0	20%	7.0%
Weighted Totals (Contribution to Total Score)											2.8	3.0	2.0	2.8	0.7		

Schedule	Weight:	15%		User Input					Value that Scores 10	Value that Scores 0	Calculated or User Selected Score					Criterion	Contribution to
Criterion	Scoring System	Required Input	Units	Option 1	Option 2	Option 3	Option 4	Option 5			Option 1	Option 1A	Option 2	Option 3	Option 4	Weight	Total Score
Initiation Time	Interpolation. Min value scores 10. Max value scores 0.	Time to move first ash	Months	32	32	41	32	32	32	41	10	10	0	10	10	30%	4.5%
Construction Duration		Estimated durations	Months	50	42	95	46	74	42	95	8	10	0	9	4	70%	10.5%
Weighted Totals (Contribution to Total Score)											1.3	1.5	0.0	1.4	0.9		

EXHIBIT DJW - 7.3.3
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Memorandum

DUKE ENERGY.

Duke Energy, CCP Closure Engineering

Date: March 7, 2017

To: Mehdi Maibodi

From: Phil Mauney, P.E.

Reviewed by: Michael Clough

Subject: Closure Options Evaluation
Cliffside Steam Station at Rogers Energy Complex
Cleveland and Rutherford Counties, North Carolina

Duke Energy Progress, (Duke Energy) has reviewed the draft *Closure Options Evaluation* for the ash basins located at Duke Energy's Cliffside Steam Station, 573 Duke Power Road, near Mooresboro, North Carolina, prepared by AMEC Foster Wheeler dated January 28, 2016. The draft *Closure Options Evaluation* involved developing ash basin closure strategies and evaluating these options relative to one another. A conceptual-level design for each closure option was developed to provide required inputs to enable this comparison. The evaluation criteria and process defined in the January 28, 2016 draft *Evaluation* were used to rank the closure options and the selected option will be advanced to permit level design.

Since completion of the draft *Closure Analysis Evaluation*, additional groundwater modeling data and other information has become available. In lieu of revising and finalizing the draft *Evaluation* in its entirety, Duke Energy has reviewed and revised the scoring matrix to include results of groundwater modeling and other information since developed to evaluate potential changes to the proposed closure program. This memorandum presents a summary of the draft *Evaluation* including an overview of the closure options evaluated, the revised scoring table, a discussion of any significant changes in the draft *Evaluation* and scoring table (included herein), and identifies the most favorable option based on the outcome of the review.

Memorandum

DUKE ENERGY.

Duke Energy, CCP Closure Engineering

Date: March 7, 2016

To: Mehdi Maibodi

From: Michael Clough

Reviewed by: Daniel Duffy

Subject: Closure Options Evaluation
Marshall Steam Station
Terrel, Catawba County, North Carolina

Duke Energy Progress, (Duke Energy) has reviewed the draft *Closure Options Evaluation* for the ash basin located at Duke Energy's Mayo Station (facility or site), located at 10660 Boston Road, near Roxboro, Person County, North Carolina, prepared by (AECOM dated 2/19/2016). The draft *Closure Options Evaluation* involved developing ash basin closure strategies and evaluating these options relative to one another. A conceptual-level design for each closure option was developed to provide required inputs to enable this comparison. The evaluation criteria and process defined in the 2/19/2016 draft *Evaluation* were used to rank the closure options and the selected option will be advanced to permit level design.

Since completion of the draft *Closure Analysis Evaluation*, additional groundwater modeling data and other information has become available. In lieu of revising and finalizing the draft *Evaluation* in its entirety, Duke Energy has reviewed and revised the scoring matrix to include results of groundwater modeling and other information since developed to evaluate potential changes to the proposed closure program. This memorandum presents a summary of the draft *Evaluation* including an overview of the closure options evaluated, the revised scoring table, a discussion of any significant changes in the draft evaluation and scoring table (included herein), and identifies the most favorable option based on the outcome of the review.

DRAFT

Draft Scoring for Evaluation of Closure Options
Closure Options Evaluation Worksheet
Ash Basin Closure - Master Programmatic Document
Duke Energy

site Name: Marshall Steam Station
Date: 2/18/2016 Rev B

1	= Option-Specific User Input
1	= Calculated Value

Placeholder values have been entered in "User Input" cells to prevent division by zero error text in calculated score cells.

Threshold Criteria: All closure options must comply with the following threshold criteria based on Duke Energy Guiding Principals for Ash Basin Closure
1. Provide continued geotechnical stability meeting appropriate safety factors under applicable loading conditions
2. Provide flow capacity and erosion resistance during design storm and flooding conditions
3. Effectively mitigate groundwater impacts (in conjunction with GW remediation where present)
4. Comply with applicable state and federal regulations (e.g. North Carolina Coal Ash Management Act)

Option	Description
1	Hybrid Option #1 Hybrid footprint over areas within the ash basin waste boundary while closing in-place the ash basin "fingers"
2	Hybrid Option #2 Hybrid footprint over areas within the ash basin waste boundary and excavating the ash basin "fingers"
3	Closure by Removal #1 On-site landfill within the ash basin waste boundary
4	Closure by Removal #2 Off site third party landfill
5	Closure in Place
A	Hybrid Option A - Included stacking ash outside of the Ash Basin footprint on a greenfield area therefore it did not comply with applicable federal regulations
B	Hybrid Option B - Included stacking ash outside of the Ash Basin footprint on the adjacent Ash landfill therefore it did not comply with applicable federal regulations
C	Hybrid Option C - Included stacking ash outside of the Ash Basin footprint on the adjacent Ash landfill and a greenfield area therefore it did not comply with applicable federal regulations

Note: Options that did not meet threshold criteria should be listed in the Options Summary table above for completeness

Environmental Protection and Impacts	Weight:	30%		User Input					Value that Scores	Value that Scores 0	Calculated or User Selected Score					Criterion	Contribution to
Criterion	Scoring System	Required Input	Units	Option 1	Option 2	Option 3	Option 4	Option 5	10		Option 1	Option 2	Option 3	Option 4	Option 5	Weight	Total Score
Modeled surface water impact	Refer to EM Sub-Scoring Sheet	This Area Not Used For Interpretation of Environmental Modeling Results									6	6	8	8	6	21%	6.3%
Modeled off-site impact	Refer to EM Sub-Scoring Sheet	This Area Not Used For Interpretation of Environmental Modeling Results									10	10	10	10	10	43%	12.9%
Groundwater impact beyond the waste boundary	Refer to EM Sub-Scoring Sheet	This Area Not Used For Interpretation of Environmental Modeling Results									4	4	6	6	4	21%	6.3%
Air emissions off-site (based on miles driven)	Interpolation. Min value scores 10. Max value scores 0.	Truck miles driven	Miles	0	0	10	100	0	0	100	10	10	9	0	10	5%	1.5%
Air emissions on-site (based on gallons of fuel consumed) from closure implementation	Interpolation. Min value scores 10. Max value scores 0.	Gallons of fuel consumed	Gallons	9,550,000	7,790,000	18,640,000	15,790,000	3,870,000	3870000	18640000	6	7	0	2	10	5%	1.5%
Avoidance of greenfield disturbance	Interpolation. Min value scores 10. Max value scores 0.	Disturbed acres of greenfield	Acres	25	60	125	155	25	25	155	10	7	2	0	10	5%	1.5%
Weighted Totals (Contribution to Total Score)											2.3	2.3	2.3	2.2	2.4		

Cost	Weight:	35%		User Input					Value that Scores	Value that Scores 0	Calculated or User Selected Score					Criterion	Contribution to
Criterion	Scoring System	Required Input	Units	Option 1	Option 2	Option 3	Option 4	Option 5	10		Option 1	Option 2	Option 3	Option 4	Option 5	Weight	Total Score
Closure Cost	Interpolation. Min value scores 10. Max value scores 0.	Closure Cost	USD	$192,600,000	$192,700,000	$432,900,000	$1,612,800,000	$139,800	$ 139,800.00	$ 1,612,800,000.00	8.8	8.8	7.3	0.0	10.0	80%	28.0%
Operation, Maintenance and Monitoring Cost		OM&M Cost	USD	$5,900,000	$6,600,000	$6,800,000	$3,100,000	$6,600,000	$ 3,100,000.00	$ 6,800,000.00	2.4	0.5	0.0	10.0	0.5	20%	7.0%
Weighted Totals (Contribution to Total Score)											2.6	2.5	2.0	0.7	2.8		

Schedule	Weight:	15%		User Input					Value that Scores	Value that Scores 0	Calculated or User Selected Score					Criterion	Contribution to
Criterion	Scoring System	Required Input	Units	Option 1	Option 2	Option 3	Option 4	Option 5	10		Option 1	Option 2	Option 3	Option 4	Option 5	Weight	Total Score
Initiation Time	Interpolation. Min value scores 10. Max value scores 0.	Time to move first ash	Months	36	36	54	36	30	30	54	8	8	0	8	10	30%	4.5%
Construction Duration		Estimated durations	Months	111	111	210	201	99	99	210	9	9	0	1	10	70%	10.5%
Weighted Totals (Contribution to Total Score)											1.3	1.3	0.0	0.5	1.5		

EXHIBIT DJW - 7.6.2
Page 1 of 2

Riverbend Steam Station

Coal Ash Excavation Plan

DUKE ENERGY®

2015 Update

Table of Contents

I. Statement of Purpose

Duke Energy Carolinas, LLC (Duke Energy or the Company) is required by Part II, Section 3(b) of the Coal Ash Management Act of 2014 (Session Law 2014-122) (Coal Ash Act or Act) to close, in accordance with Part II, Section 3(c) the coal combustion residuals (CCR) surface impoundments located at the Riverbend Steam Station, National Pollutant Discharge Eliminations System Permit No. NC0004961 in Gaston County (Riverbend) as soon as practicable, but not later than August 1, 2019.

This Coal Ash Excavation Plan (Plan) represents Phase I and other subsequent phase(s) activities to satisfy the requirements outlined in Part II, Sections 3(b) and 3(c), Subparagraphs 1 and 2 of the Act and the requests set forth in the North Carolina Department of Environment Quality's (NC DEQ) (formerly known as North Carolina Department of Environment and Natural Resources) August 13, 2014 letter titled "Request for Coal Ash Excavation Plans for Asheville Steam Electric Generating Plant, Dan River Combined Cycle Station, Riverbend Steam Station, L.V. Sutton Electric Plant" (NC DEQ Letter).

The NC DEQ letter specifically requests that the Plan include 1) soil and sedimentation erosion control measures, 2) dewatering, and 3) the proposed location(s) of the removed ash. These requirements are found in this updated Plan. The NC DEQ Letter was sent by the North Carolina Department of Environment and Natural Resources, which was renamed North Carolina Department of Environmental Quality by Session Bill 2015-241.

This is a revision of the Phase I Excavation Plan dated November 13, 2014, which covers the first 27 months of ash basin excavation activities, including the initiation of basin dewatering, site preparation, ash basin preparation and ash removal from the basins at Riverbend. Phase I is defined as December 2014 through March 2017. The Plan will generally be updated and submitted to NC DEQ annually.

The Plan covers some of the work required by Part II, Sections 3(b) and 3(c) of the Coal Ash Act. The Act requires the closure of the ash basins as soon as practicable, but no later than August 1, 2019. However, the Act contains no requirement for the submittal of an excavation plan of the kind presented here. Thus, while the formulation, submittal, and review of this Plan will assist in Duke Energy's work to close the ash basin, its ultimate approval is an action not specifically required by statutory, regulatory, or other applicable authority.

The precise scope of work in excavating the ash basins has been determined by applicable laws, rules, permits, and approvals that control the activities to be performed under the Plan. There are several external and internal factors that could potentially affect the precise scope of the work to be performed under the Plan in Phase I. As a consequence, neither the submittal of this Plan nor its acknowledgement by NC DEQ should be taken as requiring actions different from such applicable requirements. Duke Energy submits this Plan to NC DEQ based on the understanding that it may be necessary to take actions that deviate from the Plan in the future, and the Company reserves the right to make such changes after NC DEQ's acknowledgement of the Plan.

II. General Facility Description

Riverbend is located off of Horseshoe Bend Beach Road near the town of Mt. Holly in Gaston County, NC on the south bank of the Catawba River. The seven-unit station began commercial operation in 1929 with two units and then expanded to seven by 1954. At its peak, the generating facility had a capacity of 454 megawatts. As of April 1, 2013, all of the coal-fired units were retired.

The CCR from Riverbend's coal combustion operations was historically processed in the ash basin system located on the northeast side of the property adjacent to the Catawba River. The discharge from the ash basin system is permitted through Outfall #002 to the Catawba River in the Catawba River Basin by NC DEQ's Division of Water Resources under the National Pollutant Discharge Elimination System (NPDES) Permit No. NC0004961. Riverbend is being decommissioned and no active ash placement or sluicing is occurring within the ash basin system.

Ash Basin System

The ash basin system was an integral part of the station's NPDES permitted wastewater treatment system, which predominantly received inflows from the ash removal system, station yard drain sump, and stormwater flows. During station operations, inflows to the ash basin were highly variable due to the cyclical nature of station operations. The current ash basin system consists of a Primary Ash Basin and a Secondary Ash Basin, which are separated by an intermediate dam. For the purpose of stormwater management, the Ash Stack is also within the ash basin system.

The ash basin system is located approximately 2,400 feet to the northeast of the power plant, adjacent to the Catawba River, as shown on Figure 1. The Primary Ash Basin is impounded by an earthen embankment dam, referred to as Primary Dam (GASTO-97), located on the west side of the Primary Ash Basin. The Secondary Ash Basin is impounded by an earthen embankment dam, referred to as Secondary Dam (GASTO-98), located along the northeast side of the Secondary Ash Basin.

Originally, the ash basin at Riverbend consisted of a single basin commissioned in 1957. It was expanded in 1979 to its current configuration. In 1979, the original single basin was divided by constructing a divider dam (Intermediate Dam (GASTO-99)) to form two separate basins (Primary Ash Basin and Secondary Ash Basin). This modification improved the original basin's overall ability for suspended solids removal. The Intermediate Dam was built over sluiced ash to a crest of 730 feet mean sea level (msl). At the same time, the Secondary Dam crest elevation remained at 720 feet msl. At present, the Primary Ash Basin and the Secondary Ash Basin are estimated to contain approximately 2.6 million and 1.0 million tons of CCR, respectively.

The inflows from the ash removal system and the station yard drain sump were directed through sluice lines into the Primary Ash Basin. The discharge from the Primary Ash Basin to the Secondary Ash Basin is through a concrete discharge tower located near the divider dam. The surface area of the Primary Ash Basin is approximately 41 acres with an approximate maximum basin elevation of 724 feet msl. The surface area of the Secondary Ash Basin is approximately 28 acres with an approximate maximum basin elevation of 714 feet msl. The full basin elevation of Mountain Island Lake is approximately 647 feet msl.

Although the station is retired, stormwater and wastewater effluent from other non-ash-related station flows to the ash basin are discharged in compliance with the station's NPDES permit to the Catawba River through a concrete discharge tower located in the Secondary Ash Basin. The concrete discharge tower drains through a 30-inch diameter corrugated metal pipe into a concrete-lined channel. The channel extends from the Secondary Ash Basin to an NPDES Outfall #002 that discharges to the Catawba River. The Secondary Ash Basin elevation is controlled by the use of concrete stop logs.

Ash Stack

An ash fill deposit, known as the "Ash Stack," was constructed from ash removed from the Primary and Secondary Ash Basins during basin clean-out projects. The Ash Stack was utilized for periodic ash basin clean-outs to prolong the life of the ash basins. The Ash Stack is a 29-acre area located south of the Primary Ash Basin and contains approximately 1.4 million tons of CCR. The Ash Stack was constructed during two ash basin clean-outs; the last recorded ash basin clean-out project was in 2007. The Ash Stack area currently has a 1.5 to two feet of soil cover and vegetation that has been maintained following the last deposition in this area. For the purpose of water management, the stormwater run-off from the Ash Stack area is routed to the ash basin system.

Cinder Pit and Other Identified Ash Storage Areas

Prior to construction of the ash basin, bottom ash (cinders) was deposited in a primarily dry condition in the "Cinder Pit" and other areas near the cinder pit and coal pile. The Cinder Pit is approximately 13 acres and is located in a triangular area northeast of the coal pile and northwest of the rail spur (See Figure 1). This area was utilized for storage of ash material at the station prior to the installation of precipitators and a wet sluicing system. The Cinder Pit contains predominantly dry cinders and is currently covered with dense vegetation. The Cinder Pit contains approximately 203,000 tons of CCR.

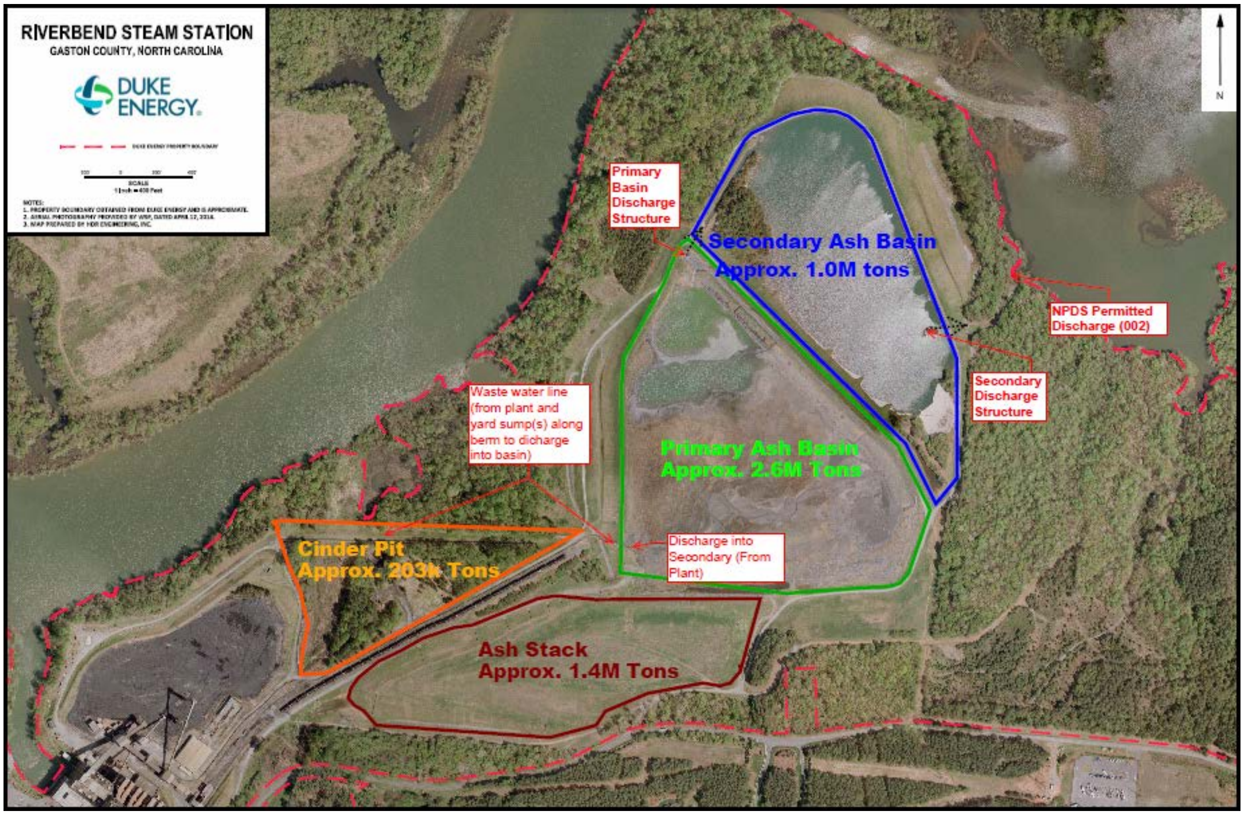

Figure 1: Riverbend Steam Station

III. Project Charter

The Company has formed an internal team, the Ash Basin Strategic Action Team (ABSAT). This team is dedicated to executing a comprehensive strategy for oversight and closure of all of the Company's ash basins.

Dewatering of the ash basins and the removal of ash from the site will be performed within project phases, Phase I and Subsequent phase(s). Required permits for each phase are set forth in Section IX of this Plan. Phase I will include the initial removal of ash from the Ash Stack and basins, bulk dewatering, decanting of the Primary Ash Basin, and completing any other subsequent permitted activities.

A dewatering plan for the ash basins has been completed and contracts have been issued to implement the dewatering plan. Duke Energy has submitted an application to modify its NPDES Wastewater Permit to include controls to be implemented during dewatering activities. Dewatering will begin once the modified permit is received and required treatment components are in place.

During Phase I, the Company will continue to perform the pre-construction and planning activities for the subsequent phase(s). These activities include project planning, development of new ash disposition options, and completion of additional required permitting that may be necessary for ash removal from the the ash basins and Cinder Pit. Knowledge and opportunities for program improvement obtained during Phase I of the project will be applied to the subsequent phase(s).

Project Charter Objectives

Phase I Objectives

1. Initiate the removal of ash from the Riverbend site
2. Plan activities for the subsequent phase(s), including development of option(s) for proposed ash disposal or beneficial use location(s)
3. Validate production rates to meet project requirements
4. Dewater ash basins
5. Gain knowledge and opportunities for program improvement that can be applied to the subsequent phase(s)

Subsequent Phase(s) Objectives

1. Continue dewatering of basins
2. Remove remaining ash from the Ash Stack, Cinder Pit, Primary Ash Basin and Secondary Ash Basin
3. Submit permit applications for next subsequent phase (if applicable)

Project Charter Scope

Phase I Scope

1. Finalize end location(s) for removed ash and obtain all required permits
2. Obtain applicable permits for work in Phase I
3. Install site erosion and sedimentation control measures
4. Begin site preparation activities, including mobilization
5. Prepare and install truck load out and truck wash for transportation by truck
6. Initiate a pilot program for excavation and transportation of approximately 120,000 tons of ash by truck to the R&B landfill located in Homer, GA, to the landfills located at the Marshall Steam Plant in Sherrills Ford, NC, and to the Brickhaven Structural Fill in Moncure, NC

7. Prepare and install rail load out spur for transportation by rail
8. Excavate and transport approximately 1.8 million tons of ash from the Ash Stack and basins to an approved storage site
9. Engineer plan to stop water inputs into the ash basins
10. Initiate rerouting of inflows to the ash basins
11. Install a wastewater treatment system to facilitate dewatering discharge requirements
12. Begin dewatering the Primary and Secondary Ash Basins
13. Plan activities for subsequent phase(s) and submit an updated Plan
14. Begin site preparation activities for the subsequent phase(s)
15. Assess, including delineation, the potential remediation efforts in the Cinder Pit
16. Submit and/or obtain remaining required permit applications for ash removal activities for subsequent phase(s)
17. Identify and develop additional location(s) for removed ash for subsequent phase activities (if applicable), including obtaining all required permits

Subsequent Phase(s) Scope

1. Prepare remaining required permit applications for next subsequent phase for ash removal activities (if applicable)
2. Finalize and/or develop additional location(s) for removed ash (if applicable) and obtain required permits
3. Complete activities to stop basin inflows
4. Complete basin dewatering
5. Excavate and transport the remaining ash from Riverbend to an approved landfill or structural fill location
6. Complete closure activities for Primary and Secondary Ash Basins as outlined in Part II, Sections 3(b) and 3(c), Subparagraphs 1 and 2 of the Coal Ash Act. Cinder Pit closure will be completed as part of overall site closure, but is not subject to the requirements of Part II, Sections 3(b) and 3(c), Subparagraphs 1 and 2 of the Coal Ash Act

IV. Critical Milestone Dates

Critical Milestones within the Plan are summarized in the table below.

MILESTONE	NO LATER THAN DATE	STATUS
Submit Excavation Plan	November 15, 2014	Completed November 13, 2014
Complete Comprehensive Engineering review	November 30, 2014	Completed November 30, 2014
Excavation Plan Acknowledgement by NC DEQ	February 17, 2015	Completed February 2, 2015
Receive Industrial Stormwater (ISW) Permit	March 5, 2015	Completed May 15, 2015
Commence work – ash removal	Final permit approval + 60 Days	Completed May 21, 2015 after receipt of ISW Permit
Submit Updated Excavation Plan	December 31, 2015	On track
Submit Updated Excavation Plan	December 31, Annually	On track
Eliminate stormwater discharge into impoundments	December 31, 2018	On track
Impoundments closed per Part II, Sections 3(b) and 3(c) of the Coal Ash Act	August 1, 2019	On track

V. Erosion and Sedimentation Control Plan

The Erosion and Sedimentation Control (E&SC) plans for the excavation of the Ash Stack, construction of the rail infrastructure, and haul roads have been developed, submitted to NC DEQ, and approved. Modification of the E&SC plans for the excavation of the ash basins and Cinder Pit area will be developed and submitted as required.

Modifications from E&SC plans for subsequent phase(s) will be approved by NC DEQ prior to installation and initiation of subsequent phase work.

The approved contractor will install the E&SC measures indicated in the plan. All control measures will be maintained through the project in accordance with the E&SC plans.

VI. Dewatering Plan

The Riverbend ash basins will be dewatered to facilitate the removal of ash and to mitigate risk. An engineered dewatering plan for Riverbend has been developed, and dewatering will begin once the modified permit is received and required treatment components are in place.

Primary Ash Basin

The free water in the Primary Ash Basin will be pumped to the Secondary Ash Basin to minimize hydraulic pressure on the intermediate dam. The maximum free water drawdown rate will be one foot over seven days. Following free water removal, accumulated stormwater will be removed at a maximum rate of two feet over one day.

After removal of free water, the entrapped water level within the Primary Ash Basin will be lowered by approximately ten feet.

Secondary Ash Basin

The free water in the Secondary Ash Basin will be pumped to the NPDES permitted discharge Outfall 002. The maximum free water drawdown rate will be one foot over seven days. Following free water removal, accumulated stormwater will be removed at a maximum rate of two feet over one day.

VII. Proposed Location(s) for Removed Ash

Phase I of the Plan includes the excavation and removal of approximately 1.8 million tons of ash from the Ash Stack and basins. Subsequent phase(s) will remove the remaining ash at the site. Ash removed from the site is being transported by the contractor to permitted facilities. The ash storage location will be managed and maintained to ensure environmental compliance with all applicable rules and regulations.

Phase I: Storage Sites

A pilot program for ash removal began on May 21, 2015 to transport ash by truck to the Waste Management R&B Landfill in Homer, GA. Ash transport to the landfills located at the Marshall Steam Station in Sherrill's Ford, NC began on July 27, 2015. Initial ash shipments by truck from Riverbend to the Brickhaven Structural Fill began on October 23, 2015. Ash transportation to the R&B Landfill was terminated in September 2015, but the transport of ash to the Marshall Landfill and the Brickhaven Structural Fill is expected to continue into the first quarter of 2016, at which time ash transport by rail to the Brickhaven Structural Fill can commence.

STORAGE SITE	LOCATION	APPROXIMATE AMOUNT (TONS)	CCR STORAGE
R&B Landfill	Homer, GA	15,762 (actual)	Landfill
Marshall FGD and Industrial Landfills	Sherrills Ford, NC	110,000	Landfill
Brickhaven Structural Fill	Moncure, NC	1,750,000	Structural Fill

R&B Landfill

A total of 15,762 tons of ash has been removed from the site and transported to the R&B landfill in Homer, GA, which is a permitted facility.

Marshall FGD and Industrial Landfills

The FGD and industrial landfills are located at the Duke Energy Marshall Steam Station facility in Sherrills Ford, NC. Both are permitted facilities and are currently receiving CCR materials from the Marshall Steam Station operation.

Brickhaven Structural Fill

The Brickhaven Structural Fill is located at the Brickhaven Mine near the city of Moncure in Chatham County, NC. It resides on approximately 299 acres. Ash will be transported and will be used as fill material for a structural fill project at the reclaimed mine. The Brickhaven Structural Fill will comply with the requirements set forth in Part III, Sections 4(b) and (c) of the Coal Ash Act.

Contingent Plan: Storage Sites

In the event of any issues with accepting ash at the Brickhaven Structural Fill, the Colon Structural Fill has been determined as a suitable alternative site.

Colon Structural Fill

The Colon Structural Fill is located at the Colon Mine in Sanford, NC. Ash may be transported from Riverbend to the Colon Structural Fill to be used as fill material for a structural fill project at the reclaimed mine.

In the event the structural fill options are not available, the Anson County Landfill, located in Polkton, NC, as well as the R&B Landfill, located in Homer, GA, have been identified as the alternate locations. Both landfills are permitted solid waste landfills. Material will be transported by rail or truck.

The Company continues to develop and evaluate contingency storage locations in the event this scenario becomes unobtainable. Contingency plans currently being developed include assessing alternate ash storage locations and beneficial use.

Subsequent Phase(s): Storage Sites

The project team will utilize lessons learned from Phase I to develop an off-site storage strategy and/or alternative beneficial use site(s) that will provide the improvements below:

- Provide a reliable, long-term, cost-effective, solution for ash designated for removal
- Support development of a diverse supplier program to drive innovation and competition
- Establish performance baselines and the system to optimize excavation, transportation, and storage of ash

VIII. Transportation Plan

Ash will be transported from the site via rail car and/or highway trucks to the off-site facilities. Transportation will be conducted by approved transporters and will meet Department of Transportation (DOT) and other applicable federal, state, and local regulations. Drivers will follow all DOT regulations pertaining to the trucking, including DOT bridge laws.

Phase I: Transportation

As previously noted in Section VII above, a pilot program for ash removal began with the transportation of ash by truck to the Waste Management R&B Landfill in Homer, GA, Marshall Steam Station landfills and the Brickhaven Structural Fill. Truck transportation is expected to continue into the first quarter of 2016, at which time ash transport by rail to the Brickhaven Structural Fill will begin.

A rail loading system is currently under construction at Riverbend that would transport ash to the Brickhaven Structural Fill. Once rail loading/unloading systems have been installed and established at Riverbend and at the Brickhaven Structural Fill, Riverbend will have the ability to transport ash by rail or truck. The rail system is being constructed to have the ability to transport an approximate total of 100,000 - 160,000 tons of ash per month.

Contingent Plan: Transportation

Trucking will be a continued option in support of ash transportation by rail.

Subsequent Phase(s): Transportation

The transportation plan and any other options will be reviewed and could be amended during Phase I and in subsequent phase(s) to enhance the excavation process and objectives.

IX. Environmental Permitting Plan

Phase I will include initiating excavation and removal of ash from the Ash Stack. Implementation of Phase I can begin once the permitting for Phase I is in place, although different permitting may be necessary prior to initiating subsequent phase work. Permitting activities for subsequent phase(s) will be included in Phase I.

Throughout this project, Duke Energy will continue to seek confirmation that all necessary approvals have been identified.

Excavation of ash creates potential for stormwater impacts. The facility holds approved erosion and sedimentation control plans and associated Construction Stormwater Permits for ash removal. Also, NC DEQ has indicated that an NPDES industrial stormwater permit is required to transport ash. The Company received the Industrial Stormwater Permit to support ash removal at the site. Pursuant to the requirements of the Industrial Stormwater Permit, a stormwater pollution prevention plan (SPPP) incorporating best management practices has been created and is currently being implemented. Future modifications to the permit/plan will be managed as necessary.

NC DEQ has recently indicated that modification of the NPDES Wastewater Permit may be required to initiate removal of free water from inactive ash basins. Duke Energy has submitted additional information to NC DEQ for its consideration to support incorporating dewatering requirements into the Company's pending NPDES permit application. The Company is working with the United States Environmental Protection Agency and NC DEQ with a goal of identifying the regulatory framework that will allow the removal of free-standing water from inactive basins to move forward.

There are no jurisdictional wetlands/streams associated with the removal of the Ash Stack or Primary or Secondary Ash basins in Phase I. Future wetland/stream impacts and jurisdictional determinations will be managed through the United States Army Corps of Engineers with particular attention paid to the difference between jurisdictional wetlands/streams under Section 404 and those arising from Section 401 waters.

Transfer of the mining permit and receipt of an individual structural fill permit has been obtained by the mine reclamation project owner/operator to accept the ash.

Riverbend ash is not classified as a DOT hazardous material.

Subsequent phase(s) will include continued dewatering and continued excavation and removal of ash from the Ash Stack, Primary and Secondary Ash Basins, and the Cinder Pit area.

Before shipping ash to a third-party RCRA Subtitle D landfill, waste characterization and approval will be completed. The necessary Dam Safety approvals will be obtained to cover activities on or around jurisdictional dams. Breaching of the dams will require Dam Safety approval. Any impacted wells or piezometers will be abandoned in accordance with NC DEQ requirements. Fugitive dust will be managed to mitigate impacts to neighboring areas. Impacts to threatened and endangered species will be avoided.

No additional site-specific or local requirements have been identified.

Permit Matrix

MEDIA	PERMIT	RECEIVED DATE / TARGET DATE	COMMENTS
Water	NPDES Industrial Stormwater Permit	May 15, 2015	Previous Target Date was March 5, 2015. NC DEQ issued the ISW permit to the Company on May 15, 2015. SPPP implementation date is November 15, 2015.
	NPDES Wastewater Permit – Major Modification	4th Quarter 2015	Previous Target Date was August 28, 2015. NC DEQ has indicated dewatering activities, including free water removal, may require NPDES wastewater permit modification. Based on this, a letter was sent to NC DEQ on September 5, 2015 requesting a path forward.
	Jurisdictional Wetland and Stream Impacts/ 404 Permitting and 401 WQC	N/A	There are no identified jurisdictional wetland/stream impacts.
Dam Safety	Dam Decommissioning Request Approval	June 30, 2016	Transportation and excavation activities must not impact a jurisdictional dam or dike. Excavation activities are initially staying 50 feet away from the jurisdictional dike. Removing ash from the Primary and Secondary Ash Basins will have to be reviewed with Dam Safety. Breaching of dike will require Dam Safety approval.
Waste	Individual Structural Fill Permit	Received Permit to Operate October 15, 2015	Mine Reclamation Owner/Operator obtained an individual structural fill permit as set forth in Part II, § 130A-309.215 of the Coal Ash Act.

MEDIA	PERMIT	RECEIVED DATE / TARGET DATE	COMMENTS
Other Requirements	Site specific Nuisance/Noise/Odor/Other Requirements including DOT and FERC Requirements	N/A	None identified.

X. Contracting Strategy

The Ash Management Program strategy is to engage multiple contractors, drive competition, create system-wide innovation, and develop a collection of best practices. Duke Energy has engaged specialized contractor(s), who are experienced in coal ash excavation, transportation, and storage, and continues to evaluate other potential contractors. Duke Energy provides in-depth oversight, coordination, and monitoring of the contractors to ensure the work is performed appropriately. Duke Energy's core values of safety, quality, and protection of the environment are non-negotiable and will not be compromised in order to increase productivity or generate cost savings. The Company continues to evaluate alternate approaches, methods, and contracting solutions and will adjust our strategy, as necessary.

XI. Environmental, Health, and Safety Plan

Protecting workers, the public, the community, and the environment

Duke Energy is committed to the health, safety, and welfare of employees, contractors, and the public, and to protecting the environment and natural resources. During all phases of the project work, Duke Energy and its contractors will follow the Duke Energy Safe Work Practices Manual, the ABSAT Environmental, Health, and Safety supplement document, and any additional requirements. Occupational health and safety expectations include oversight and continuous improvement throughout the project.

The project includes comprehensive environmental, health and safety plans encompassing all aspects of the project work, including at the plant, in transit, and at the final destination as needed.

In addition to adhering to all applicable environmental, health, and safety rules and regulations, Duke Energy and its contractors will focus on ensuring the safety of the public and protection of the environment during each phase of the project.

XII. Communications Plan

Many different external stakeholders, including neighbors, government officials, and media have an interest in this project. For example, there is the potential for facility neighbors and the general public to see or experience construction-related impacts, such as truck traffic, landscape changes, or noise. The Company is committed to providing information by proactively communicating about the project activities to potentially affected parties and responding to inquiries in a timely manner. The project team has coordinated with Duke Energy's Corporate Communications Department to develop and implement a comprehensive external communications plan tailored to the specific needs of each phase of the project.

XIII. Glossary

TERM	DEFINITION
ABSAT	Duke Energy organization acronym for Ash Basin Strategic Action Team
Ash Basin	Synonymous with Coal Combustion Residual Impoundment. A topographic depression, excavation, or dammed area that is primarily formed from earthen materials; without a base liner approved for use by Article 9 of Chapter 130A of the North Carolina General Statutes or rules adopted thereunder for a combustion products landfill or coal combustion residuals landfill, industrial landfill, or municipal solid waste landfill; and an area that is designed to hold accumulated coal combustion residuals in the form of liquid wastes, wastes containing free liquids, or sludge, and that is not backfilled or otherwise covered during periods of deposition.
Ash Stack	Storage area for dry ash
Beneficial Use	Projects promoting public health and environmental protection, offering equivalent success relative to other alternatives, and preserving natural resources
Bottom Ash	The agglomerated, angular ash particles formed in pulverized coal furnaces that are too large to be carried in the flue gases and collect on the furnace walls. Bottom ash falls through open grates to an ash hopper at the bottom of the furnace.
Bulk Water	Water above the ash contained in the ash basin. Synonymous with free water
Coal Ash Excavation Plan	Plan required by NC DEQ letter dated August 13, 2014, including a schedule for soil and sedimentation erosion control measures, dewatering, and the proposed location of the removed ash

TERM	DEFINITION
Coal Ash Management Act of 2014	North Carolina Session Law 2014-122
Coal Combustion Residuals (CCR)	Residuals, including fly ash, bottom ash, boiler slag, mill rejects, and flue gas desulfurization residue produced by a coal-fired generating unit
Dewatering	The act of removing bulk and entrapped water from the ash basin
Duke Energy Safe Work Practices Manual	Document detailing the Duke Energy safety guidelines
Entrapped Water	Flowable water below the ash surface, which creates hydrostatic pressure on the dam
Excavation Activities	Tasks and work performed related to the planning, engineering, and excavation of ash from an ash basin
Excavation Plan	Refer to Coal Ash Excavation Plan
Free Water	Water above the ash contained in the ash basin. Synonymous with bulk water
Fly Ash	Very fine, powdery material, composed mostly of silica with nearly all particles spherical in shape, which is a product of burning finely ground coal in a boiler to produce electricity and is removed from the plant exhaust gases by air emission control devices.
NPDES	National Pollutant Discharge Elimination System
NPDES Permit	A permit that regulates the direct discharge of wastewater to surface waters
Off-Site Facility	A structural fill or mine reclamation for the long-term storage of coal combustion residuals
Permit	Federal, state, county, or local government authorizing document

XIV. Reference Documents

REF	DOCUMENT	DATE
1	Letter to Duke Energy, Request for Excavation Plans	August 13, 2014
2	Coal Ash Management Act of 2014	September 20, 2014

DRAFT

Draft Scoring for Evaluation of Closure Options
Closure Options Evaluation Worksheet
Ash Basin Closure - Master Programmatic Document
Duke Energy

site Name: Marshall Steam Station
Date: 2/18/2016 Rev B

1	= Option-Specific User Input
1	= Calculated Value

Placeholder values have been entered in "User Input" cells to prevent division by zero error text in calculated score cells.

Regional Factors	Weight:	15%		User Input					Value that Scores 10	Value that Scores 0	Calculated or User Selected Score					Criterion Weight	Contribution to Total Score
Criterion	Scoring System	Required Input	Units	Option 1	Option 2	Option 3	Option 4	Option 5			Option 1	Option 2	Option 3	Option 4	Option 5		
Plan or potential for beneficial reuse of site	Subjective	Not Used For Subjective Scoring									10					5%	0.8%
Imported soil needs	Interpolation. Min value scores 10. Max value scores 0.	Soil Imported	CY	1,100,000	1,150,000	2,540,000	750,000	1,630,000	750000	2540000	8	8	0	10	5	5%	0.8%
Beneficial reuse of CCR	Interpolation. Max value scores 10. Zero value scores 0.	Fraction Used	None	0.1	0.1	0	0	0.1	0.1	0	10	10	0	0	10	15%	2.3%
Transportation impact (based on miles driven)	Interpolation. Min value scores 10. Max value scores 0.	Miles Driven	Miles	0	0	10	100	0	0	100	10	10	9	0	10	65%	9.8%
Noise impact due to on-site activity (based on proximity of neighbors to on-site work areas)	Subjective 0 to 10: 10 is the least noise; 0 is the most noise.	Not Used For Subjective Scoring									6	6	1	2	9	5%	0.8%
View impact (based on final height of storage facility and land uses within viewshed)	Subjective 0 to 10; 10 is the least visual; 0 is the most visual.										4	7	2	10	10	5%	0.7%
Weighted Totals (Contribution to Total Score)											**1.4**	**1.4**	**0.9**	**0.2**	**1.4**		

Constructability	Weight:	5%		User Input					Value that Scores 10	Value that Scores 0	Calculated or User Selected Score						
Criterion	Scoring System	Required Input	Units	Option 1	Option 2	Option 3	Option 4	Option 5			Option 1	Option 2	Option 3	Option 4	Option 5		
Consider stormwater management, geotechnical, and dewatering	Subjective 0 to 10: 10 is the least commplicated; 0 is the most complicated	Not Used For Subjective Scoring									4	3	4	5	8	100%	5.0%
Weighted Totals (Contribution to Total Score)											**0.2**	**0.2**	**0.2**	**0.3**	**0.4**		
Total Score For Each Option (On a Scale of 0 to 10)											**7.9**	**7.6**	**5.5**	**3.8**	**8.5**		

CLOSURE OPTIONS

For the Marshall Steam Station, AECOM in conjunction with Duke Energy developed the following five conceptual closure options for evaluation:

- Option 1: Hybrid Closure #1 Hybrid footprint over areas within the ash basin waste boundary while closing in-place the Ash Basin "fingers"
- Option 2: Hybrid Closure #2 Hybrid footprint over areas within the ash basin waste boundary and excavating the Ash Basin "fingers"
- Option 3: Closure by removal #1 On-site landfill with the Ash Basin waste boundary
- Option 4: Closure by removal #2 Off-site third party landfill
- Option 5: Closure in Place

Option 1 consists of the excavation of ash materials from the proposed Closure-by-Removal Areas which requires the construction of a deep mixing method wall to stabilize the cut-slope at the close-in-place / closure-by-removal interface, and the subsequent placement of these ash materials within the proposed Hybrid #2 Ash Closure Area, thereby reducing the Ash Basin footprint. Following these excavation and placement activities, the Hybrid #2 Ash Closure Area, along with four of the Ash Basin "Fingers", will be capped with an infiltration barrier / cap system meeting the requirements of the Federal CCR Rule and CAMA, and the Dam will be partially removed.

Option 2 consists of the excavation of ash materials from the proposed Closure-by-Removal Areas shown on Figure B4-1, which requires the construction of several deep mixing method walls to stabilize the cut-slopes at the close-in-place / closure-by-removal interface locations, and the subsequent placement of these ash materials within the proposed Hybrid #2 Ash Closure Area, thereby reducing the Ash Basin footprint. Following these excavation and placement activities, the Hybrid #2 Ash Closure Area, along with one of the Ash Basin "Fingers," will be capped with an infiltration barrier / cap system meeting the requirements of the Federal CCR Rule and CAMA.

Option 3 consists of the excavation of ash materials from the Industrial Landfill Ash Excavation Area, the placement of these ash materials within the On-Site Staging Area, and the construction of the additional Industrial Landfill phases. Once the Industrial Landfill is constructed, the proposed Closure-by-Removal Area shown on Figure B6-1 will be excavated, and all excavated ash material will subsequently be placed within the Industrial Landfill. The Industrial Landfill will be capped with an infiltration barrier / cap system meeting the requirements of the Federal CCR Rule and CAMA, and the Dam will be partially removed.

Option 3B consists of excavating ash materials from the proposed Closure-by-Removal Area, placing 3 million CY of those ash materials in a new 16-acre phase of liner within the Existing On-Site Landfill, as shown in Figure B3. Once the new Industrial Landfill is permitted and constructed, another 2.5M CY of excavated ash materials from the proposed Closure-by-Removal Area can subsequently be placed within the new Industrial Landfill (which would have a 33-acre footprint). The new phase of the existing landfill and the new Industrial Landfill will be capped with an infiltration barrier/cap system meeting the requirements of the Federal CCR Rule and CAMA.

Option 4 consists of the excavation of the entire Ash Basin, partial removal of the Dam, and the disposal of the ash material in an existing, off-site (Subtitle D) third party landfill, resulting in Closure-by-Removal.

Option 5 consists of a partial Dam removal and leaving the ash material within the Ash Basin, which will be capped with an infiltration barrier / cap system meeting the requirements of the Federal CCR Rule and CAMA. This is the Closure-in-Place option.

A more detailed overview of each closure option is presented in the draft *Evaluation.* Also included in the draft Evaluation and not reproduced herein are estimated quantities of ash and soil materials associated with each closure option, figures detailing each option, order of magnitude comparative costs for each option, and other additional information developed to support the comparisons.

EVALUATION MATRIX

Duke Energy has prepared a scoring matrix to provide consistent evaluation of closure options for each of their various site locations. This scoring evaluation tool is attached and considers the following primary criteria:

- Environmental Protection and Impacts
- Cost
- Schedule
- Regional Factors
- Constructability

Different overall weights have been programmatically assigned to these criteria and may not be changed. However, within each criteria there are various categories that have default values for their weighted contribution to the overall criteria score and those individual categories may have their weighting adjusted based on site conditions. Detail application of each of these criteria to the selected closure options is presented in the draft *Evaluation*. This includes discussion about project design, permitting, and implementation schedule for the options.

The changes to the scoring table consist of the modeled surface water impact criteria, the modeled off-site impact criteria, and the groundwater impact beyond the waste boundary criteria.

Appendix

<u>Evaluation Criteria and Results</u>

The scoring matrix provided in the attached table, scores each option on a scale of 0 (least favorable) to 10 (most favorable) for each of the specified criteria. The scores for each option are then summed based on specified criterion weighting, resulting in an overall weighted score for each option. The results of the scoring evaluation for the Mayo closure options are summarized in the following table:

Criterion	Option				
	1	**2**	**3**	**4**	**5**
Environmental Protection and Impacts	2.3	2.3	2.3	2.2	2.4
Cost	2.6	2.5	2.0	0.7	2.8
Schedule	1.3	1.3	0.0	0.5	1.5
Regional Factors	1.4	1.4	0.9	0.2	1.4
Constructability	0.2	0.2	0.2	0.3	0.4
Total Score	7.9	7.6	5.5	3.8	**8.5**

CLOSING

Based on an evaluation of the criteria established by Duke Energy (environmental protection/impacts, cost, schedule, regional factors and constructability), Option 2 Closure-in-Place is identified as the most favorable option, and can be implemented because of the Low-Risk classification by NCDENR. The options evaluation is consistent with the draft Evaluation.

Design Report - DRAFT

Ash Basin Closure – Conceptual Design

for

Dan River Steam Station

January 22, 2014

Prepared by: AMEC
2801 Yorkmont Road, Suite 100
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CONTENTS

FIGURES

APPENDICES

1.0 INTRODUCTION

Duke Energy (Duke) contracted AMEC Environment & Infrastructure, Inc. (AMEC) to develop a conceptual closure plan for the Dan River Steam Station ash ponds and ash storage areas. AMEC prepared this Design Report to present the proposed conceptual closure plan.

1.1 Purpose

Duke is decommissioning the Dan River Steam Station including the ash management facilities that include ash ponds and ash storage areas. AMEC and Duke have undertaken limited and preliminary activities to characterize site conditions, evaluate ash pond and storage area closure options, and select a preferred closure option for conceptual design.

This Design Report presents the conceptual design and provides initial engineering and environmental analyses conducted to evaluate whether or not the preferred closure option is technically feasible. Furthermore, this Design Report is intended to communicate the conceptual design to stakeholders as a point of beginning for the permitting and design process of closing the ash management facilities. Another result of the Design Report is that it helps in further developing necessary technical considerations and identifying areas requiring further evaluation and understanding for detailed design.

1.2 Background

The Dan River Steam Station is located on the north side of the Dan River in Eden, Rockingham County, North Carolina, approximately 35 miles north of Greensboro, North Carolina. The project location from a regional context is illustrated in Figure 1. The site within the extents of the Dan River Steam Station property boundary is illustrated in Figure 2. Ash management facilities include two ash ponds and two ash storage areas known as the Primary Pond, Secondary Pond, Ash Fill 1, and Ash Fill 2. Duke Energy is in the process of decommissioning coal and gas fired generating units at the station. Ash management facility closure is being undertaken as part of the overall station decommissioning efforts.

AMEC developed an exploration program to characterize the geologic, hydrogeologic, geotechnical, and environmental setting and existing conditions. The exploration program was implemented in June and July 2013, the results of which are reported in the Data Report (AMEC, 2013a). AMEC evaluated the geologic, hydrogeologic, geotechnical, and environmental information and presented results and findings in the Interpretation and Analysis Report (AMEC, 2013b). Duke and AMEC developed, considered, and evaluated several closure options considering a variety of criteria and recommended the preferred option that is presented in this report.

1.3 Report Organization

The report is organized in the following sections:

- The conceptual closure plan is presented in Section 2.0.
- Engineering and environmental analyses supporting the conceptual closure plan are summarized in Section 3.0.
- Conclusions are provided in Section 4.0
- Supporting information is summarized in tables, illustrated in figures, and provided in engineering and environmental evaluations in appendices with this report.

2.0 CONCEPTUAL CLOSURE PLAN

The closure approach and the conceptual closure plan are presented in this Section. The closure approach is summarized to provide context on how the preferred closure option was developed and selected.

2.1 Closure Approach

The closure approach applied to develop the conceptual closure plan entailed defining closure objectives, recognizing the closure steps, identifying closure options, and establishing the context of physical and environmental closure scenarios.

Closure has different meanings for different regulatory stakeholders. For example, decommissioning an ash basin from the Dam Safety jurisdiction is different from environmental stakeholders' closure expectations. Independent of the regulatory perspective, the fundamental closure goals applied herein include:

- isolating the source by providing a physical barrier between ash and the environment;
- restricting the amount of ash in contact with water by reducing water infiltration into ash, migration through ash, and dewatering the ash basins; and
- providing a stable ash basin and storage area configuration.

2.1.1 Closure Steps

A stepwise approach was implemented to develop the proposed plan to close ash basins and storage areas. The closure approach followed these steps:

- assessing the site geologic, hydrogeologic, geotechnical, and environmental conditions;
- identifying and evaluating closure options then selecting the preferred closure option; and
- developing a conceptual design to validate the preferred closure option.

After conceptual design is complete, the anticipated next step is to develop detailed design for permitting and construction.

2.1.2 Closure Options

The following general categories of closure options were considered.

- Clean Closure – excavating ash and affected soils beneath the ash and moving them to an appropriate solid waste management facility;
- Closure in Place – by dewatering, stabilizing, and providing anengineered cover system;
- Hybrid Closure – closure of selected areas by clean closure and relocating that material to other areas on-site for closure in place; and

- Closure & Reuse – closure of selected areas while incorporating current or future planned uses.

Based on the understanding of site conditions gained through assessment activities reported in the Data Report (AMEC, 2013) and the Interpretation and Analyses Report (AMEC, 2013) in conjunction with closure option evaluation conducted by Duke and AMEC, the hybrid closure was selected as the preferred approach. The hybrid closure approach provides an efficient use of limited land and soil resources, optimizes construction and long-term costs, and will be protective of human health and the environment. The closure approach described herein may be considered in terms of the physical closure and environmental closure.

2.1.3 Physical Closure

The physical closure of ash basins and storage areas is focused on isolating and stabilizing the ash while providing a physical barrier to the environment. The physical closure is presumed to include design and construction of an engineered cover system. The physical closure approach will generally follow established solid waste management closure practices for engineered cover systems. Regardless of the environmental conditions and environmental closure approach, the physical closure of ash basins seeks to decommission them from Dam Safety jurisdiction. The physical closure is expected to improve conditions in support of the companion environmental closure.

2.1.4 Environmental Closure

The environmental closure may take one of several pathways depending on the nature, extent, and characteristics of the constituents of interest (COI). Activities undertaken to characterize the site conditions provide the basis for better understanding the nature and extent of groundwater and soil conditions, and provide meaningful context for advancing the environmental closure. Future steps will focus on further characterizing the soil and groundwater conditions to develop the environmental closure approach.

It is envisioned that environmental closure will likely entail one or more of the following remedial approaches: monitored natural attenuation; enhanced monitored natural attenuation; and active/passive remedies. Results of characterization activities indicate that COI exist above regulatory standards at the compliance boundaries (AMEC, 2013b). Treatment methods or remedial strategies need to be further identified and evaluated and will be developed in conjunction with the physical closure.

2.1.5 Preferred Closure Concept

The preferred closure concept is the hybrid approach described as follows:

- move all Primary and Secondary Pond ash into the Ash Fill 1 and 2 area;
- close Ash Fill 1 and 2 in place with an engineered cover system;

- remove Primary and Secondary Pond embankments and re-use the soil for cover system construction and pond area restoration;
- grade the ash pond areas to promote drainage and stabilization; and
- remediate groundwater (either passively or actively) and implement long-term groundwater monitoring.

The preferred closure concept is illustrated at a conceptual level in Figure 3. This preferred closure concept was developed and evaluated through drawings and engineering and environmental evaluations summarized in remaining sections of this Design Report.

2.2 Conceptual Closure Plan

The conceptual closure plan is communicated, in part, through a series of drawings. The drawings illustrate existing conditions and the proposed closure concept for the ash ponds and ash fills. Drawings are provided in Appendix 1. The drawings include:

1. Cover Sheet
2. Existing Conditions – Topographic Map
3. Existing Conditions – Aerial Photograph
4. Proposed Closure Plan
5. Cross Section 1
6. Cross Section 2

Grading plans were developed to understand the potential capacity (volume) available in Ash Fills 1 and 2 to receive pond ash. Grading plans were developed based on a 3.2 horizontal to 1 vertical (3.2H:1V) slope inclination to represent the average slope from the toe to crest. Detailed design slopes will be graded at 3H:1V with a bench for an access road. Engineering evaluations were completed to estimate the volume of ash in the ponds and storage areas. Results of engineering evaluations are provided in Section 3.11 and indicate there is adequate capacity in the ash fill areas to accept the pond ash.

The conceptual closure plan considered stormwater management during construction and for proposed final conditions to confirm stormwater could be adequately provided for. Engineering evaluations supporting stormwater management considerations are provided and summarized in Section 3.5. During construction stormwater will be managed primarily through sediment basins. Sediment basins were sized and locations were proposed to confirm it was possible to provide adequate measures during construction. During ash pond dewatering and excavation, stormwater will be managed within the Primary and Secondary Pond footprints in part by leaving the embankments in place and utilizing the existing outlet structure until late stages of construction. It is envisioned that existing stormwater outfalls will be maintained during and after construction. After ash has been removed from the ponds and placed in Ash fills 1 and 2, and once adequate stormwater management has been provided within and around the pond footprints, the embankments will be removed. Embankment soil will be used for cover system construction and regrading pond footprints. It is envisioned that a stormwater management pond will be constructed in the eastern portion of the Secondary Pond footprint to manage and treat stormwater flow from the upgradient ash fills. In addition, this stormwater management pond may receive potential seepage originating from the upgradient slopes of the former ash ponds. The final stormwater management pond is proposed to discharge to the Dan River at the location of the current Secondary Pond outfall.

The volume of soil in the embankments, stockpiled in Ash Fill 1, existing cover soil for Ash Fill 1 and Ash Fill 2, and cut and fill from the proposed ash pond grading was estimated. The volume of soil required to build engineered cover systems for Ash Fill 1 and 2 was estimated. Results of the estimates summarized in Section 3.11 indicate there is enough soil generated on-site to complete an engineered cover system construction.

Engineering and environmental evaluations supporting the conceptual closure plan are summarized in Section 3 and appendices to this Design Report.

3.0 ENGINEERING AND ENVIRONMENTAL EVALUATIONS

3.1 Purpose

Engineering and environmental analyses, calculations, and modeling were conducted to support the conceptual closure plan. These evaluations are preliminary in nature and extent and are intended to determine the viability of the proposed closure concept. Furthermore these evaluations identify areas of interest and limitations that will be considered in future characterization, assessment, and design activities for final closure. The engineering and environmental evaluations are organized in the following general categories:

- geotechnical (slope stability, liquefaction potential, settlement);
- stormwater;
- geologic site conceptual model and hydrogeologic modeling;
- environmental (leachability, fate and transport, geochemistry); and
- civil design (dewatering, soil demand, quantity estimate).

3.2 Slope Stability

Slope stability analyses were conducted to evaluate the global static and pseudo-static stability of the proposed final configurations of Ash Fill 1 and Ash Fill 2. The slope stability calculations are presented in Appendix 2 and summarized as follows.

Two idealized cross sections were evaluated, one representing Ash Fill 1 and the other representing Ash Fill 2. The cross sections represent geologic strata and a groundwater table position generally consistent with the geologic site conceptual model presented in the companion Interpretation and Analysis Report (AMEC, 2013b). Final slope configurations were modeled based on 3H:1V slopes. Material properties were adopted from results of site characterization activities and historical material properties reported in the companion Interpretation and Analyses Report (AMEC, 2013b).

A computer software program, GeoStudio SLOPE/W Version 7.23, was used to evaluate slope stability. The slope stability analyses were performed using the Spencer’s method of slices evaluating potential circular failure surfaces. Results of analyses indicate that factors of safety for static and pseudo-static conditions are satisfied.

A sensitivity analysis of ash strength parameters was conducted by back-calculating strength parameters that achieved the minimum factors of safety. The sensitivity analysis results indicate the strength parameters required to achieve minimum factors of safety are reasonably achievable for ash fill. Results indicate that the potential failure surfaces with the lowest factors of safety are shallow (a few feet) circular surfaces. Deep seated failure surfaces through the base of the ash fills were considered and resulted in factors of safety greater than the shallow surfaces.

Future detailed design will need to consider slope stability of the proposed final design grades developed for specific cross-sections. Interim conditions during dewatering and excavating ash from the ponds and during fill placement may also be considered in detailed design. In addition, detailed design will need to consider veneer stability of the anticipated engineered cover system. Though veneer stability was not evaluated at this time, there is significant precedent demonstrating stable configurations of engineered cover systems at slope inclinations of 3H:1V. It is therefore believed that veneer stability of the future cover system can be achieved.

Future design efforts will need to further characterize the strength properties of existing ash in the ash fills, existing soil in the ash fills, natural soils, pond ash to be placed as engineered fill, and soils to be used as engineered fill.

3.3 Liquefaction Potential

Prior to developing closure concepts, evaluating them, and selecting the preferred closure concept, it was envisioned that liquefaction potential would be evaluated for concepts where the existing ash ponds remained in place. As the selected closure concept is to dewater and remove ash from the ponds, liquefaction potential was not evaluated.

Results of exploration activities indicate there is ash a few to several feet below the water table in Ash Fills 1 and 2. Though not dismissed altogether, it is AMEC's opinion that this condition is unlikely to result in the potential for liquefaction for the following reasons: there is a mounting body of evidence that demonstrates stability against liquefaction for substantial overfills on top of ash ponds; and results of the evaluations reported herein indicate that the proposed final design configuration may result in the water table dropping, possibly near or below the bottom of the ash fills.

However, liquefaction potential should remain a consideration during future design efforts. In particular, the strength of ash located at the base of the ash fills and within the ponds should be further characterized. In addition, stability while dewatering and removing ash from the ponds should be considered.

3.4 Settlement

Analyses were conducted to evaluate the settlement of the proposed final configurations of Ash Fill 1 and Ash Fill 2. The settlement calculations are presented in Appendix 3 and summarized as follows.

Settlement was evaluated representing locations of Ash Fill 1 and Ash Fill 2 at three existing borings and assuming proposed final fill elevations. Analyses assume that existing ash fill cover soils will be removed and that soil fill within Ash Fill 1, on the order of 20 to 40 feet thick, will be removed prior to placement of new ash from the ponds. Existing ash consolidation characteristics were developed from empirical correlations and past experience. Settlement was evaluated using an elastic settlement model. Results indicate settlement on the order 20 to 35 inches within Ash

Fill 1 and 19 inches within Ash Fill 2. Experience indicates that ash settles immediately in response to loading and negligible long-term settlement is expected after fill has been placed. The estimated magnitude of settlement is acceptable for the proposed closure concept. Future design efforts will need to further characterize the settlement properties of existing ash in the ash fills.

3.5 Stormwater

The objective during conceptual design was to consider and evaluate stormwater management system requirements and to demonstrate that stormwater management may be reasonably provided. The stormwater evaluation is provided in Appendix 4 and summarized as follows.

The stormwater evaluation established watersheds representing pre-construction, during-construction, and post-construction conditions and estimated stormwater runoff base flows at each watershed outfall for those conditions. Stormwater management during construction is anticipated to be achieved in large part through sediment basins. Accordingly, the area required for sediment basins was evaluated and conceptual plans were developed that demonstrate the location of sediment basins. This is a meaningful exercise because it demonstrates there is adequate space to provide for stormwater management during construction. In addition, stormwater management will be provided during construction by relying on the pond embankments and outfall structure to remain in place until late stages of construction when they are removed. Existing outfalls will be used during-construction.

The locations of existing outfalls will be used for post-construction outfall locations. Much of the ash fill and ash pond areas will be graded to drain to a proposed stormwater pond located in the eastern side of the Secondary Pond and intended to discharge at the location of the current Secondary Pond outfall. Some of the ash fill and ash pond areas will be graded to drain to the locations where existing reinforced-concrete pipes beneath the ash ponds discharge to the Dan River. Some of the ash pond areas will be graded to drain as sheet flow to the Dan River. Some of the sediment basins envisioned for construction conditions are proposed to remain for final conditions.

This evaluation indicates the proposed final conditions will meet permanent water quality and quantity requirements. No impervious area will be added within the disturbed area of the site, therefore the post-construction runoff volume will be less than or equal to the pre-construction runoff volume.

3.6 Site Conceptual Model

A site conceptual model was developed based on results of geologic, hydrogeologic, and geotechnical exploration activities to provide a working description of the site characteristics used in various evaluations herein. The site conceptual model was developed and presented in the companion Interpretation and Analysis Report (AMEC, 2013b) and was illustrated, in part through cross sections and groundwater contour maps provided in that report.

3.7 Hydrogeologic Modeling

The objective of the hydrogeologic modeling calculation is to evaluate the post-closure groundwater position after removing the ash ponds and installing an engineered cover system over the ash fills. The calculation also estimates how long it may take for the groundwater level to change. The calculation is provided in Appendix 5 and summarized as follows.

The calculations are performed using a simplified, two-dimensional (2D) numerical groundwater flow model that uses the MODFLOW code to solve the finite-difference equations. MODFLOW is the industry standard for groundwater modeling. The pre- and post-processing software Groundwater Vistas Version 6.53, Build 15 is used to construct, calibrate, and display results from the model. The model is based on the first 2,600 feet of Cross-Section B-B' presented in the "Interpretation and Analysis Report Ash Basin Closure – Conceptual Design."

Model input parameters are developed from limited site-specific hydraulic conductivity (K) data obtained from site characterization activities of the current project scope, from values reported in literature, and from experience-based professional judgement. To help evaluate the sensitivity of model results to input parameters, two different steady-state calibrations are performed for the model; one with comparatively low hydraulic conductivity and groundwater recharge, and a second with comparatively high hydraulic conductivity and groundwater recharge.

Particle tracking simulations are completed with each steady-state model to evaluate potential groundwater flow paths and seepage velocities. The MODPATH code is used to trace particle flow paths and calculate particle travel times within Groundwater Vistas. Each calibrated model is then used to perform a simulation during which the Secondary Pond will be removed, engineered cover system will be installed over Ash Fill 1, and water levels will be allowed to respond to a new, stable position.

The results of the hydrogeologic modeling calculation are summarized below:

- Observed groundwater levels along cross-section B-B' can be approximately simulated using the simplified, 2D numerical groundwater flow model;
- Removing the Secondary Pond results in lowering of the groundwater table, possibly below the bottom of Ash Fill 1. The two different model calibrations indicate that dewatering may take 13 or 30 years depending on the hydraulic conductivity of subsurface materials and recharge assumptions.
- Calculated particle travel times from Ash Fill 1 to the Secondary Pond range from 8 years to 66 years depending on the hydraulic conductivity, particle release location, and effective porosity specified in the model.
- The 2D model indicates the potential for a long-term seepage face to develop where the native residuum meets the new fill material in the vicinity of the former

Secondary Pond. Management options such as diversion trenches should be considered to address potential seepage both during and after construction.

The above results should be considered accurate to a “proof of concept” level only due to the simplified, 2D approach used in the modeling. Results should not be relied upon as the sole basis for decision making. A major limitation of this model is that it assumes that hydraulic influences outside of the modeled cross-section, such as groundwater inflow, spatially variable recharge, surface drainage features, or geologic heterogeneity, will not significantly affect the predicted groundwater position. In reality, the hydraulic influences beyond the modeled cross-section will influence predicted groundwater response. Additional data collection, especially related to the hydraulic conductivity of subsurface materials, and a more robust, 3D model are necessary to reduce the uncertainty of predicted dewatering times and groundwater seepage velocities.

3.8 Leachability

The objective of the leachability calculation was to evaluate the potential for various constituents of interest (COI) found in ash and soil (i.e., the matrix) to leach above the current groundwater 2L values. The leachability calculations are provided in Appendix 6 and summarized as follows.

Four primary COIs (arsenic, boron, iron, and manganese) were identified in soil and ash samples across the site at concentrations that consistently exceeded the North Carolina Department of Natural Resources (NCDENR) derived protection of groundwater standards (POGs). This evaluation was performed to evaluate whether Duke can calculate new site-specific Protection of Groundwater (SSPOG) values that are more realistic with respect to actual matrix conditions.

The leachability calculation was performed in general accordance with the “Guidance for Determining Leachability by Analysis of SPLP Results” established by the Florida Department of Environmental Protection, Draft Version 1.7 (dated May 2008). Currently, the NCDENR does not have a guidance document for performing this analysis, but allows this evaluation where current POGs do not seem realistic for various site.

A simple linear regression statistical analysis was performed on the total COI and leachable SPLP sampling results for each of the four primary COIs: arsenic, boron, iron, and manganese. The data obtained and evaluated for arsenic and iron support the position that a SPPOG should be used. For arsenic, the evaluation resulted in an increase of the POG from 5.8 to 28 mg/kg., which if accepted by the NCDENR, would permit screening out of 5 of 11 POG exceedances observed in current soil sample data set. For iron, the evaluation resulted in an increase of the POG from 150 mg/kg to 1,500 mg/kg. However, iron concentrations in soil were still observed at high levels consistently above the new SSPOG. Conversely data for boron and manganese indicates SSPOG is more conservative than the current POG standard and due to the distribution of groundwater impacts, does not warrant the use of a SSPOG.

Overall, completion of the leachability calculation has shown that there is potential for increasing POGs for certain COI which would eliminate or screen out some exceedances and ultimately reducing the volume of ash and soil requiring potential remediation. However, the evaluation also identified the need for more ash and soil SPLP data to support and provide a greater degree of confidence to eliminate various COIs in support of the detailed design. The additional samples will allow for refinement of the SSPOGs.

3.9 Fate and Transport

The purpose of the fate and transport evaluation presented in Appendix 7 provides an initial semi-quantitative evaluation of the fate and transport of dissolved constituents in groundwater as controlled by flow rates, constituent chemistry, and site-specific geochemical controls. General trends in site geochemistry, compound of interest distribution and concentration, and groundwater flow rates are used to derive inferences regarding present and future fate and transport.

The calculation uses the results from a simplified, two-dimensional (2D) numerical groundwater flow model (MODFLOW and MODPATH) based on geologic cross-section B-B'. The site-specific chemical fate and transport evaluation is general in nature and semi-quantitative.

The primary assumption behind the calculation is that a 2D numerical groundwater flow model based on the geologic cross-section B-B' included in the "Interpretation and Analysis Report Ash Basin Closure – Conceptual Design" can be reasonably used to calculate the groundwater flow rates in current conditions. A second assumption is that the calculated current flow rates are representative of flow rates after pond removal. The third assumption is that the observed distributions and concentrations in site chemistry are a true representation of the current conditions.

The simplified 2D numerical groundwater flow model reasonably simulates observed field conditions along cross-section B-B'. Particle tracking and extrapolation provides approximate travel times for leachate impacted groundwater of 25 to 175 years. Most of the range in travel time is due to the large percentage of the groundwater flow path that is a potential source of leachate. The expected relative transport rates are, highest to lowest, $B >> As \geq Fe \approx Mn$. Currently, there is interaction between COI impacted ground water and the ponds that attenuates COIs by dilution prior to discharge to the Dan River. Pond removal will eliminate the pond-groundwater mixing and interaction. It is expected that any corrective action involving the ponds will affect COI fate and transport. Corrective action planning will need to encompass predictive capability for groundwater flow and COI fate and transport.

3.10 Geochemistry

The purpose of the geochemical evaluation is to evaluate the distribution of the groundwater COIs (As, B, Fe, Mn) with the goal of: evaluating possible geochemical controls on the observed distribution of COIs; and, the potential for corrective action for these COIs through Monitored Natural Attenuation. The geochemical evaluation is provided in Appendix 8.

A total of 10 compounds that exceed 2L standards for groundwater have been identified. They are arsenic, boron, cadmium, chromium, iron, lead, manganese, nickel, selenium, and sulfate. As identified in the I&A Report (AMEC, 2013) the four COI in groundwater are As, B, Fe, and Mn. Compounds of interest are those regulated compounds that are found in several wells at concentrations above 2L standards.

The following assumptions apply to this calculation. The evaluation is limited to observations derived from the OW well series sampling and analysis events in Fall 2013 and the historic data for groundwater sampling of the MW series of wells spanning 1993 through Fall 2013. The COI are limited to As, B, Fe, and Mn as described in Section 5.1.7 of the I&A report (AMEC, 2013). The analytical results used are representative of in-situ aquifer conditions at the time and place of sampling. Historic groundwater flow rates and directions are not significantly different than as represented in the current conceptual model.

An evaluation of the distribution of COI in groundwater was accomplished using visual inspection. The general properties of compounds and aquifer controls that would result in attenuation of those compounds were described. Graphical analysis was used to evaluate background concentrations. Graphical inspection of general water quality trends along flow path was conducted to validate flow assumptions inherent to the conceptual model (not presented here). Monitored Natural Attenuation (MNA) evaluations were partly accomplished by comparing analytical results from co-located water and geomedia pairs. Solid sample COI levels were determined on geomedia samples collected from within or near the screened section of the appropriate well during well installation. Water analysis from both 2013 sampling rounds was used.

Water-solid ratios and the absence of As in the most down gradient wells indicate that As is undergoing natural attenuation and is not discharging to the Dan River. The current distribution of B shows very limited attenuation that may result from dilution or interaction with solids. Iron is probably not a COI based on background concentrations, and showed limited attenuation based on distribution. Iron did not show attenuation through water-solid ratio calculations. The distribution of Mn indicates that attenuation is taking place along groundwater flow path; however Mn did not show attenuation through water-solid ratio calculations.

3.11 Dewatering

A potential approach for dewatering ash in the Primary and Secondary Ponds was developed to facilitate planning, and help identify information needed to support detailed design. The dewatering approach is communicated through a narrative, tables, and drawings provided in Appendix 9.

The dewatering approach seeks to take advantage of gravity and time by beginning with passive, gravity drainage methods before advancing on to more active methods. The approach uses the existing discharge towers and assumes that the Secondary Pond discharge tower will serve as the only outfall throughout pond dewatering. A step-wise dewatering sequence is proposed. The potential volume of pore-water was estimated. Potential recharge water from plant operations, groundwater seepage, direct rainfall, and stormwater recharge was acknowledged. Active dewatering methods (including well point and pumping systems) and water treatment methods are recognized.

A viable sequence for dewatering the Dan River ash ponds was developed as a point of beginning for dewatering efforts and detailed design. To take advantage of gravity and time, AMEC recommends that dewatering begin as soon as possible using passive gravity methods. These efforts should be coordinated and monitored to gauge progress and gather information useful for detailed dewatering design. Dewatering efforts will need to be coordinated with Duke stakeholders to provide for dust control, safety, and possible water treatment to meet NPDES permit requirements for discharge.

3.12 Capacity Evaluation and Soil Demand

The objective of this discussion is to provide information demonstrating the proposed conceptual closure plan has adequate capacity and to estimate soil needs compared with soil availability. A quantity estimate providing detailed information about the means and methods of estimating the quantities and the results is provided In Appendix 10.

The volume of ash in the Primary and Secondary ponds was estimated based on comparison of three-dimensional surfaces using AutoCAD Civil 3D software. Existing bathymetric survey data was used to represent the ash surface and existing topographic maps combined with information from historical Duke drawings was used to approximate the bottom of the ash ponds. The volume available in Ash Fills 1 and 2 was estimated by comparing three-dimensional surfaces using AutoCAD Civil 3D software of proposed grading plans to existing grades. The capacity of Ash Fills 1 and 2 to accept ash from the ponds was evaluated based on a weight basis (in tons) because it provides the ability to account for the anticipated volume reduction from pond ash to ash placed as fill. Results indicate there is enough capacity in Ash Fills 1 and 2 to accept the estimated quantity of pond ash. Updated topographic mapping and further characterization of in-place pond and ash fill densities will be required for detailed design.

The volume of soil needed for construction of the proposed conceptual closure plan was estimated and compared with the volume of soil available on site. Soil will be needed to build an engineered cover system and regrade and vegetate the former pond footprint. Soil is available from existing cover on Ash Fills 1 and 2, soil stockpiled on Ash Fill 1, and from the ash pond embankments. Results reported in Appendix 10 indicate there is excess soil available. Detailed design efforts should seek to optimize grading plans and better balance cut and fills to reduce the soil excess as much as possible.

3.13 Quantity Estimate

Quantity estimates were prepared to support project planning and promote understanding of the scope and magnitude for constructing the proposed closure concept. Quantity estimates are provided for only for major construction components such as earthworks, ash removal, and cover system construction. Quantities include excavation of existing soils, pond ash to be removed, proposed cover system soils, proposed cover system geosynthetics, and area for seeding and restoration. A quantity estimate providing detailed information about the means and methods of estimating the quantities and the results is provided In Appendix 10.

4.0 CONCLUSIONS

This Design Report presents the conceptual design and provides initial engineering and environmental analyses conducted to evaluate whether or not the preferred closure option is technically feasible. Results provided in this report indicate the preferred closure option is technically feasible.

Based on site characterization activities conducted to better understand the site geologic, hydrogeologic, geotechnical, and environmental setting and conditions and based on evaluation of closure options considering a variety of criteria, Duke and AMEC selected a preferred closure option. The preferred closure option consists of:

- move all Primary and Secondary Pond ash into the Ash Fill 1 and 2 area;
- close Ash Fill 1 and 2 in place with an engineered cover system;
- remove Primary and Secondary Pond embankments and re-use the soil for cover system construction and pond area restoration;
- grade the ash pond areas to promote drainage and stabilization; and
- remediate groundwater (either passively or actively) and implement long-term groundwater monitoring.

The described approach represents in large part, the “physical closure” focused on isolating and stabilizing ash storage areas. The anticipated “environmental closure” may take one of several pathways depending on the nature, extent, and characteristics of the constituents of interest. The environmental pathway will be developed further during detailed design activities.

Engineering and environmental evaluations were presented within this design report. Noteworthy conclusions of these evaluations are summarized as follows.

- Slope stability analyses results indicate the proposed Ash Fills 1 and 2 closure grades satisfy minimum factors of safety.
- Liquefaction potential was considered however concluded to be unlikely on the basis that ash ponds are being removed.
- Settlement from placing pond ash as fill on top of Ash Fill 1 and 2 was evaluated and results indicate the magnitude of settlement is acceptable.
- Strormwater management concepts were developed for anticipated conditions during and after construction. Results of the evaluation were meaningful to demonstrate adequate space is available to provide stormwater management facilities and to consider the sequence of stormwater management from construction through to final conditions.
- A site conceptual model was developed based on results of geologic, hydrogeologic, and geotechnical exploration activities that provides a working description of the site characteristics used in various evaluations herein. In particular, the site conceptual model was used for hydrogeologic modeling efforts. The site conceptual model provides a strong platform for organizing and planning future site characterization activities supporting detailed design.

- Hydrogeologic modeling was conducted to evaluate post-closure groundwater conditions. Though the modeling is preliminary and limited by simplifying assumptions made to approximate complex site conditions, results do indicate that the groundwater table position with the Ash Fills will lower in response to the proposed closure activities.
- Leachability evaluation results indicate there is potential to increase protection of groundwater standards for certain constituents of interest.
- The preliminary hydrogeologic modeling was used to evaluate the fate and transport of dissolved constituents. Groundwater flow rates are generally slow at about 20-35 ft/year. Travel times from Ash Fill 1 to the Dan River vary from about 25 to 175 years. COI will move slower than the groundwater flow rate due to attenuation, dilution, and mixing. Relative transport rates for the COI are, B>>As≥Fe≈Mn, highest to lowest. The ultimate fate of all dissolved COI that are not fully attenuated is the same as groundwater, discharge to the Dan River. B, Fe and Mn are present at the compliance boundary at concentrations exceeding 2L standards.
- An evaluation of geochemical data was conducted to determine if natural processes are reducing the concentration of COI in groundwater. Natural attenuation of As was observed, attenuation of Fe and Mn is probable, and attenuation of B is uncertain based on the currently available data.
- A viable sequence of dewatering the Primary and Secondary Ponds, based initially on gravity methods than advancing to more active approaches, was developed as a point of beginning for dewatering efforts and detailed design.
- The proposed Ash Fill1 and 2 grading plans have the capacity to accept the estimated volume of ash to be removed from the Primary and Secondary Ponds.
- There is enough soil from onsite from reusing the ash pond embankments, ash fill cover soils, and soil stockpiled in Ash Fill 1 to construct the proposed closure option.

5.0 References

AMEC, 2013a, Data Report, Ash Basin Closure – Conceptual Design, for Dan River Steam Station, Prepared by AMEC, 2810 Yorkmont Road, Suite 100, Charlotte, North Carolina, September 19, 2013.

AMEC, 2013b, Interpretation and Analysis Report – DRAFT, Ash Basin Closure – Conceptual Design, Prepared by AMEC, 2810 Yorkmont Road, Suite 100, Charlotte, North Carolina, December, 2013.

DRAFT

Draft Scoring for Evaluation of Closure Options
Closure Options Evaluation Worksheet
Ash Basin Closure - Master Programmatic Document
Duke Energy

Site Name: Cliffside Steam Station - Unit 1-4 Ash Basin
Date: March 7, 2017

1	= Option-Specific User Input
1	= Calculated Value

Placeholder values have been entered in "User Input" cells to prevent division by zero error text in calculated score cells.

Threshold Criteria: All closure options must comply with the following threshold criteria based on Duke Energy Guiding Principals for Ash Basin Closure
1. Provide continued geotechnical stability meeting appropriate safety factors under applicable loading conditions
2. Provide flow capacity and erosion resistance during design storm and flooding conditions
3. Effectively mitigate groundwater impacts (in conjunction with GW remediation where present)
4. Comply with applicable state and federal regulations (e.g. North Carolina Coal Ash Management Act)

Option	Description
1A	Closure by Removal - Onsite Landfill
1B	Closure by Removal - Offsite Landfill

Note: Options that did not meet threshold criteria should be listed in the Options Summary table above for completeness

Environmental Protection and Impacts	Weight:	30%		User Input					Value that Scores 10	Value that Scores 0	Calculated or User Selected Score					Criterion	Contribution to
Criterion	Scoring System	Required Input	Units	Option 1A	Option 1B						Option 1A	Option 1B				Weight	Total Score
Modeled surface water impact	Refer to EM Sub-Scoring Sheet	This Area Not Used For Interpretation of Environmental Modeling Results														21%	6.3%
Modeled off-site impact	Refer to EM Sub-Scoring Sheet	This Area Not Used For Interpretation of Environmental Modeling Results														43%	12.9%
Groundwater impact beyond the waste boundary	Refer to EM Sub-Scoring Sheet	This Area Not Used For Interpretation of Environmental Modeling Results														21%	6.3%
Air emissions off-site (based on miles driven)	Interpolation. Min value scores 10. Max value scores 0.	Truck miles driven	Miles	0	156				0	156	10	0				5%	1.5%
Air emissions on-site (based on gallons of fuel consumed) from closure implementation	Interpolation. Min value scores 10. Max value scores 0.	Gallons of fuel consumed	Gallons						0	0	0	0				5%	1.5%
Avoidance of greenfield disturbance	Interpolation. Min value scores 10. Max value scores 0.	Disturbed acres of greenfield	Acres	10	10				10	10	0	0				5%	1.5%
Weighted Totals (Contribution to Total Score)											0.2	0.0					

Cost	Weight:	35%		User Input					Value that Scores 10	Value that Scores 0	Calculated or User Selected Score					Criterion	Contribution to
Criterion	Scoring System	Required Input	Units	Option 1A	Option 1B	Option 3	Option 4	Option 5			Option 1A	Option 1B				Weight	Total Score
Closure Cost	Interpolation. Min value scores 10. Max value scores 0.	Closure Cost	USD	$10,685,000	$27,600,000				$ 10,685,000.00	$ 27,600,000.00	10.0	0.0				80%	28.0%
Operation, Maintenance and Monitoring Cost		OM&M Cost	USD	$3,015,000	$2,709,000				$ 2,709,000.00	$ 3,015,000.00	0.0	10.0				20%	7.0%
Weighted Totals (Contribution to Total Score)											2.8	0.7					

Schedule	Weight:	15%		User Input					Value that Scores 10	Value that Scores 0	Calculated or User Selected Score					Criterion	Contribution to
Criterion	Scoring System	Required Input	Units	Option 1A	Option 1B	Option 3	Option 4	Option 5			Option 1A	Option 1B				Weight	Total Score
Initiation Time	Interpolation. Min value scores 10. Max value scores 0.	Time to move first ash	Months	6	6				6	6	0	0				30%	4.5%
Construction Duration		Estimated durations	Months	15	30				15	30	10	0				70%	10.5%
Weighted Totals (Contribution to Total Score)											1.1	0.0					

EXHIBIT DJW - 7.4.2
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Revision G
May 5, 2016

DRAFT

Draft Scoring for Evaluation of Closure Options
Closure Options Evaluation Worksheet
Ash Basin Closure - Master Programmatic Document
Duke Energy

Site Name: Cliffside Steam Station - Unit 1-4 Ash Basin
Date: March 7, 2017

1	= Option-Specific User Input
1	= Calculated Value

Placeholder values have been entered in "User Input" cells to prevent division by zero error text in calculated score cells.

Regional Factors	Weight:	15%		User Input					Value that Scores 10	Value that Scores 0	Calculated or User Selected Score					Criterion	Contribution to
Criterion	Scoring System	Required Input	Units	Option 1A	Option 1B	Option 3	Option 4	Option 5			Option 1A	Option 1B				Weight	Total Score
Plan or potential for beneficial reuse of site	Subjective	Not Used For Subjective Scoring									10	10				5%	0.8%
Imported soil needs	Interpolation. Min value scores 10. Max value scores 0.	Soil Imported	CY	15074	15074				15074	15074	0	0				5%	0.8%
Beneficial reuse of CCR	Interpolation. Max value scores 10. Zero value scores 0.	Fraction Used	None	0.1	0.1				0.1	0	10	10				15%	2.3%
Transportation impact (based on miles driven)	Interpolation. Min value scores 10. Max value scores 0.	Miles Driven	Miles	0	156				0	156	10	0				65%	9.8%
Noise impact due to on-site activity (based on proximity of neighbors to on-site work areas)	Subjective 0 to 10: 10 is the least noise; 0 is the most noise.	Not Used For Subjective Scoring									5	5				5%	0.8%
View impact (based on final height of storage facility and land uses within viewshed)	Subjective 0 to 10; 10 is the least visual; 0 is the most visual.										5	10				5%	0.7%
Weighted Totals (Contribution to Total Score)											1.4	0.4					

Constructability	Weight:	5%		User Input					Value that Scores 10	Value that Scores 0	Calculated or User Selected Score						
Criterion	Scoring System	Required Input	Units	Option 1A	Option 1B	Option 3	Option 4	Option 5			Option 1A	Option 1B					
Consider stormwater management, geotechnical, and dewatering	Subjective 0 to 10: 10 is the least compmplicated; 0 is the most complicated	Not Used For Subjective Scoring									7	7				100%	5.0%
Weighted Totals (Contribution to Total Score)											0.4	0.4					
Total Score For Each Option (On a Scale of 0 to 10)											5.7	1.5					

CLOSURE OPTIONS

For the Cliffside Steam Station, AMEC has developed ten (10) conceptual closure options for evaluation that are in accordance with all applicable federal, state, and local regulations and the Duke Energy Closure Programmatic Document, as summarized below:

- Unit 1-4 Retired Basin
  - 1A Closure By Removal – Onsite Landfill
  - 1B Closure By Removal – Offsite Landfill
- Unit 5 Inactive Basin
  - 1A Closure By Removal – Onsite Landfill
  - 1B Closure By Removal – Offsite Landfill
  - 1C Closure By Removal – Active Basin Beneficial Reuse
  - 3 – Closure In Place
- Active Basin
  - 1A Closure By Removal – Onsite Landfill
  - 1B Closure By Removal – Offsite Landfill
  - 2 Hybrid Closure
  - 3 Closure In Place

The following are descriptions of each evaluated option.

Removal: Units 1-4, Unit 5, Active Ash Basin

- Remove ash from basins and transfer to the onsite or an offsite landfill
- Restore excavated areas by grading to promote drainage and soil stabilization
- Remove embankment duke and grade soil to promote drainage

Hybrid: Active Ash Basin

- Consolidate ash into reduced footprint
- Close in place consolidated footprint with engineered cover system and stabilize surface
- Grade and establish vegetation on former ash areas by grading to promote drainage and soil stabilization

Close In Place: Unit 5, Active Ash Basin

- Leave current ash basin footprints as is and close in place
- Close in place with minimal grading of ash to provide positive drainage with an engineered final cover system and stabilize surface.

EVALUATION MATRIX

Duke Energy has prepared a scoring matrix to provide consistent evaluation of closure options for each of their various site locations. This scoring evaluation tool is attached and considers the following primary criteria:

- Environmental Protection and Impacts
- Cost
- Schedule
- Regional Factors
- Constructability

Different overall weights have been programmatically assigned to these criteria and may not be changed. However, within each criteria there are various categories that have default values for their weighted contribution to the overall criteria score and those individual categories may have their weighting adjusted based on site conditions. Detail application of each of these criteria to the selected closure options is presented in the draft *Evaluation*. This includes discussion about project design, permitting, and implementation schedule for the options.

- The scoring tables were revised to reflect the GW analysis.
- To date, nearly all the Unit 1-4 basin has been excavated.
- Unit 5 excavation and spillway.

Appendix

<u>Evaluation Criteria and Results</u>

The scoring matrix provided in the attached tables, scores each option on a scale of 0 (least favorable) to 10 (most favorable) for each of the specified criteria. The scores for each option are then summed based on specified criterion weighting, resulting in an overall weighted score for each option.

Unit 1-4 Basin Criterion	**Option**

	1A	**1B**
Environmental Protection and Impacts	0.2	0.0
Cost	2.8	0.7
Schedule	1.1	0.0
Regional Factors	1.4	0.4
Constructability	0.4	0.4
Total Score	**5.7**	1.5

Unit 5 Basin Criterion	**Option**			
	1A	**1B**	**1C**	**3**
Environmental Protection and Impacts	2.4	2.4	2.6	2.4
Cost	2.1	0.7	3.1	3.5
Schedule	0.7	0.0	0.7	1.1
Regional Factors	1.4	0.4	1.4	1.4
Constructability	0.2	0.2	0.2	0.4
Total Score	6.8	3.7	8.0	**8.7**

Active Basin Criterion	Option			
	1A	**1B**	**2**	**3**
Environmental Protection and Impacts	2.2	2.2	2.3	2.3
Cost	2.2	0.7	3.3	3.5
Schedule	0.0	0.0	1.1	1.1
Regional Factors	1.4	0.4	1.3	1.4
Constructability	0.2	0.2	0.3	0.5
Total Score	6.0	3.5	8.3	**8.7**

CLOSING

Based on an evaluation of the criteria established by Duke Energy (environmental protection/impacts, cost, schedule, regional factors and constructability), Option 3 Closure-in-Place is identified as the most favorable option for both the Unit 5 Inactive Ash Basin and the Active Ash Basin, and can be implemented in the future with a Low-Risk classification by NCDEQ after the basin are re-classified in 2019.

DRAFT

Draft Scoring for Evaluation of Closure Options
Closure Options Evaluation Worksheet
Ash Basin Closure - Master Programmatic Document
Duke Energy

Site Name: Buck
Date: 3/6/17

1	= Option-Specific User Input
1	= Calculated Value

Placeholder values have been entered in "User Input" cells to prevent division by zero error text in calculated score cells.

Regional Factors	Weight:	15%		User Input					Value that Scores 10	Value that Scores 0	Calculated or User Selected Score					Criterion	Contribution to
Criterion	Scoring System	Required Input	Units	Option 1	Option 2	Option 3	Option 4	Option 5			Option 1	Option 1A	Option 2	Option 3	Option 4	Weight	Total Score
Plan or potential for beneficial reuse of site	Subjective	Not Used For Subjective Scoring									0	0	0	0	0	5%	0.8%
Imported soil needs	Interpolation. Min value scores 10. Max value scores 0.	Soil Imported	CY	0	0	0	0	0	0	NA	10	10	10	10	10	5%	0.8%
Beneficial reuse of CCR	Interpolation. Max value scores 10. Zero value scores 0.	Fraction Used	None	41	26	0	0	0	41	0	10	6	0	0	0	15%	2.3%
Transportation impact (based on miles driven)	Interpolation. Min value scores 10. Max value scores 0.	Miles Driven	Miles	7	0	0	0	76	0	76	9	10	10	10	0	65%	9.8%
Noise impact due to on-site activity (based on proximity of neighbors to on-site work areas)	Subjective 0 to 10: 10 is the least noise; 0 is the most noise.	Not Used For Subjective Scoring									2	5	0	10	1	5%	0.8%
View impact (based on final height of storage facility and land uses within viewshed)	Subjective 0 to 10; 10 is the least visual; 0 is the most visual.										3	4	0	4	10	5%	0.7%
Weighted Totals (Contribution to Total Score)											**1.2**	**1.3**	**1.1**	**1.2**	**0.2**		

Constructability	Weight:	5%		User Input					Value that Scores 10	Value that Scores 0	Calculated or User Selected Score						
Criterion	Scoring System	Required Input	Units	Option 1	Option 2	Option 3	Option 4	Option 5			Option 1	Option 1A	Option 2	Option 3	Option 4		
Consider stormwater management, geotechnical, and dewatering	Subjective 0 to 10: 10 is the least commplicated; 0 is the most complicated	Not Used For Subjective Scoring									4	2	0	10	3	100%	5.0%
Weighted Totals (Contribution to Total Score)											**0.2**	**0.1**	**0.0**	**0.5**	**0.2**		
Total Score For Each Option (On a Scale of 0 to 10)											**8.1**	**8.5**	**5.8**	**8.4**	**4.4**		

CLOSURE OPTIONS

For the Buck Station, HDR in conjunction with Duke Energy developed the following five conceptual closure options for evaluation:

- Option 1: Hybrid Closure – Consolidate CCR in Cell 1
- Option 1A: Hybrid Closure – Consolidate CCR Away From the Yadkin River within Cell 1 and the southern portion of Cell 2
- Option 2: Closure by Removal and Construction of New On-site Landfill within the Cell 1 Footprint
- Option 3: Closure in Place (CIP)
- Option 4: Closure by Removal and Disposal of Excavated CCR in an Off-site Landfill

Option 1 consists of excavating CCR from Cell 2 and Cell 3 to fill and regrade Cell 1 and the ash storage area. In addition, CCR from the southern portion of Cell 1 closest to the property line would be used to fill and regrade Cell 1 and the ash storage area and this area would be graded to drain. Following these excavation and placement activities, the remainder of Cell 1 and the ash storage area would be capped with an infiltration barrier/cap system meeting the requirements of the Federal CCR Rule. This option would result in complete removal of four out of the five regulated ash basin dams with only the Cell 1 Additional Primary Dam (ROWAN-068) remaining in place.

Option 1A consists of excavating CCR from the northern portion of Cell 2 and all of Cell 3, which are near the Yadkin River, to fill and regrade the southern portion of Cell 2, Cell 1, and the ash storage area. In addition, CCR from the southern portion of Cell 1 closest to the property line would be used to fill and regrade Cell 1 and the ash storage area and this area would be graded to drain. Following these excavation and placement activities, the remainder of Cell 1 and Cell 2, and the ash storage area would be capped with an infiltration barrier/cap system meeting the requirements of the Federal CCR Rule. This option would result in complete removal of four out of the five regulated ash basin dams with only the Cell 1 Additional Primary Dam (ROWAN-068) remaining in place.

Option 2 consists of excavating CCR out of Cell 1, constructing a lined landfill within the Cell 1 footprint, then placing the excavated Cell 1 CCR in the newly constructed landfill. CCR would also be excavated from Cell 2, Cell 3, and the ash storage area and placed in the lined landfill. Following these excavation and placement activities, the lined landfill would be capped with an infiltration barrier/cap system meeting the requirements of the Federal CCR Rule. This option would result in complete removal of all five regulated ash basin dams.

Option 3 consists of regrading CCR within Cells 1, 2, and 3 to allow free drainage and provide a suitable base for cap construction. Following these regrading activities, Cells 1, 2, and 3, and the ash storage area would be capped with an infiltration barrier/cap system meeting the requirements of the Federal CCR Rule. This option would result in complete removal of three out of the five regulated ash basin dams with only the Cells 2/3 Main Dam (ROWAN-047) and Cell 1 Additional Primary Dam (ROWAN-068) remaining in place.

Option 4 consists of the excavation of CCR from Cells 1, 2, and 3, and the ash storage area and the disposal of these materials in an existing off-site lined landfill. This option would result in complete removal of all five regulated ash basin dams.

A more detailed overview of each closure option is presented in the draft *Evaluation.* Also included in the draft Evaluation and not reproduced herein are estimated quantities of ash and soil materials associated with each closure option, figures detailing each option, order of magnitude comparative costs for each option, and other additional information developed to support the comparisons.

EVALUATION MATRIX

Duke Energy has prepared a scoring matrix to provide consistent evaluation of closure options for each of their various site locations. This scoring evaluation tool is attached and considers the following primary criteria:

- Environmental Protection and Impacts
- Cost
- Schedule
- Regional Factors
- Constructability

Different overall weights have been programmatically assigned to these criteria. Detail application of each of these criteria to the selected closure options is presented in the draft *Evaluation*. This includes discussion about project design, permitting, and implementation schedule for the options.

Since the time of the draft Evaluation, North Carolina Session Law 2016-95, House Bill 630 (H.B. 630) was put into law. H.B. 630 § 130A-309.216 mandates that an impoundment owner shall identify at a minimum, impoundments at three (3) sites located within the state of North Carolina with ash stored in the impoundments that is suitable for processing for cementitious purposes and enter into a binding agreement for the installation and operation of an ash beneficiation project at each site capable of annually processing 300,000 tons of ash to specifications appropriate for cementitious products. Based on the material composistion and properties of the CCR within the basins at Buck, as well as the sites proximity to markets with demand for the material, Buck was selected as one of the sites where a ash beneficiation facility will be located for processing the onsite CCR.

Other considerations that have changed since the draft Evaluation are as follows:

- During the draft Evaluation, the assumption was made that the depth of excavation in closure by removal senarios would be to the bottom of CCR plus 2 feet of underlying soil. Since the time of the draft Evaluation, Duke Energy has been provided direction that for site located in North Carolina the depth of exaction is likely to extend to the bottom of visual CCR, dependent on the results of sampling at the bottom of excavation and analytical testing. This will reduce the assumed volume of excavation for hybrid and closure by removal options, but would not significantly change the scores or resulting identified most favorable option.
- Since the time of the draft Evaluation, a note on a historical drawing indicating that the soil used to construct the dams may have come from a borrow pit within the footprint of the basins. This lead to an increase in the assumed volume of CCR within the basins, which would increase the assumed volume of excavation for hybrid and closure by removal options, but would not significantly change the scores or resulting identified most favorable option.

EVALUATION CRITERIA and RESULTS

The scoring matrix provided in the attached table, scores each option on a scale of 0 (least favorable) to 10 (most favorable) for each of the specified criteria. The scores for each option are then summed based on specified criterion weighting, resulting in an overall weighted score for each option. The results of the scoring evaluation for the Buck closure options are summarized in the following table:

Criterion	**Option**				
	1	**1A**	**2**	**3**	**4**
Environmental Protection and Impacts	2.6	2.6	2.7	2.5	2.4
Cost	2.8	3.0	2.0	2.8	0.7
Schedule	1.3	1.5	0.0	1.4	0.9
Regional Factors	1.2	1.3	1.1	1.2	0.2
Constructability	0.2	0.1	0.0	0.5	0.2
Total Score	**8.1**	**8.5**	**5.8**	**8.4**	**4.4**

CLOSING

Based on an evaluation of the criteria established by Duke Energy (environmental protection/impacts, cost, schedule, regional factors and constructability), Option 1A Hybrid Closure Consolidating CCR Away From the Yadkin River within Cell 1 and the southern portion of Cell 2 is identified as the most favorable option, and can be implemented because of the Low-Risk classification by NCDEQ. Even though the overall scores changed and the difference in scores between the highest scoring and second highest scoring options was reduced, the most favorable option identified remains consistent with that identified in the draft Evaluation. However, at this time, the selected closure option is closure by removal of CCR with a portion of the material being processed at an on-site CCR beneficiation facility.

DRAFT

Draft Scoring for Evaluation of Closure Options
Closure Options Evaluation Worksheet
Ash Basin Closure - Master Programmatic Document
Duke Energy

Site Name: Belews Creek Steam Station
Date: 3/6/2017

1	= Option-Specific User Input
1	= Calculated Value

Placeholder values have been entered in "User Input" cells to prevent division by zero error text in calculated score cells.

Regional Factors	Weight:	15%		User Input					Value that Scores 10	Value that Scores 0	Calculated or User Selected Score					Criterion	Contribution to
Criterion	Scoring System	Required Input	Units	Option 1	Option 2	Option 3	Option 4	Option 5			Option 1	Option 2	Option 3	Option 4	Option 5	Weight	Total Score
Plan or potential for beneficial reuse of site	Subjective	Not Used For Subjective Scoring									10					5%	0.8%
Imported soil needs	Interpolation. Min value scores 10. Max value scores 0.	Soil Imported	CY	2000000	700000	500000	550000	0	0	2000000	0	7	8	7	10	5%	0.8%
Beneficial reuse of CCR	Interpolation. Max value scores 10. Zero value scores 0.	Fraction Used	None	0.1	0.1	0	0	0	0.1	0	10	10	0	0	0	15%	2.3%
Transportation impact (based on miles driven)	Interpolation. Min value scores 10. Max value scores 0.	Miles Driven	Miles	0	0	0	10	100	0	100	10	10	10	9	0	65%	9.8%
Noise impact due to on-site activity (based on proximity of neighbors to on-site work areas)	Subjective 0 to 10: 10 is the least noise; 0 is the most noise.	Not Used For Subjective Scoring									10	7	0	4	2	5%	0.8%
View impact (based on final height of storage facility and land uses within viewshed)	Subjective 0 to 10; 10 is the least visual; 0 is the most visual.										10	7	3	0	10	5%	0.7%
Weighted Totals (Contribution to Total Score)											**1.4**	**1.4**	**1.1**	**1.0**	**0.2**		

Constructability	Weight:	5%		User Input					Value that Scores 10	Value that Scores 0	Calculated or User Selected Score						
Criterion	Scoring System	Required Input	Units	Option 1	Option 2	Option 3	Option 4	Option 5			Option 1	Option 2	Option 3	Option 4	Option 5		
Consider stormwater management, geotechnical, and dewatering	Subjective 0 to 10: 10 is the least commplicated; 0 is the most complicated	Not Used For Subjective Scoring									10	3	0	5	5	100%	5.0%
Weighted Totals (Contribution to Total Score)											**0.5**	**0.2**	**0.0**	**0.3**	**0.3**		
Total Score For Each Option (On a Scale of 0 to 10)											**8.8**	**7.9**	**5.6**	**5.9**	**4.0**		